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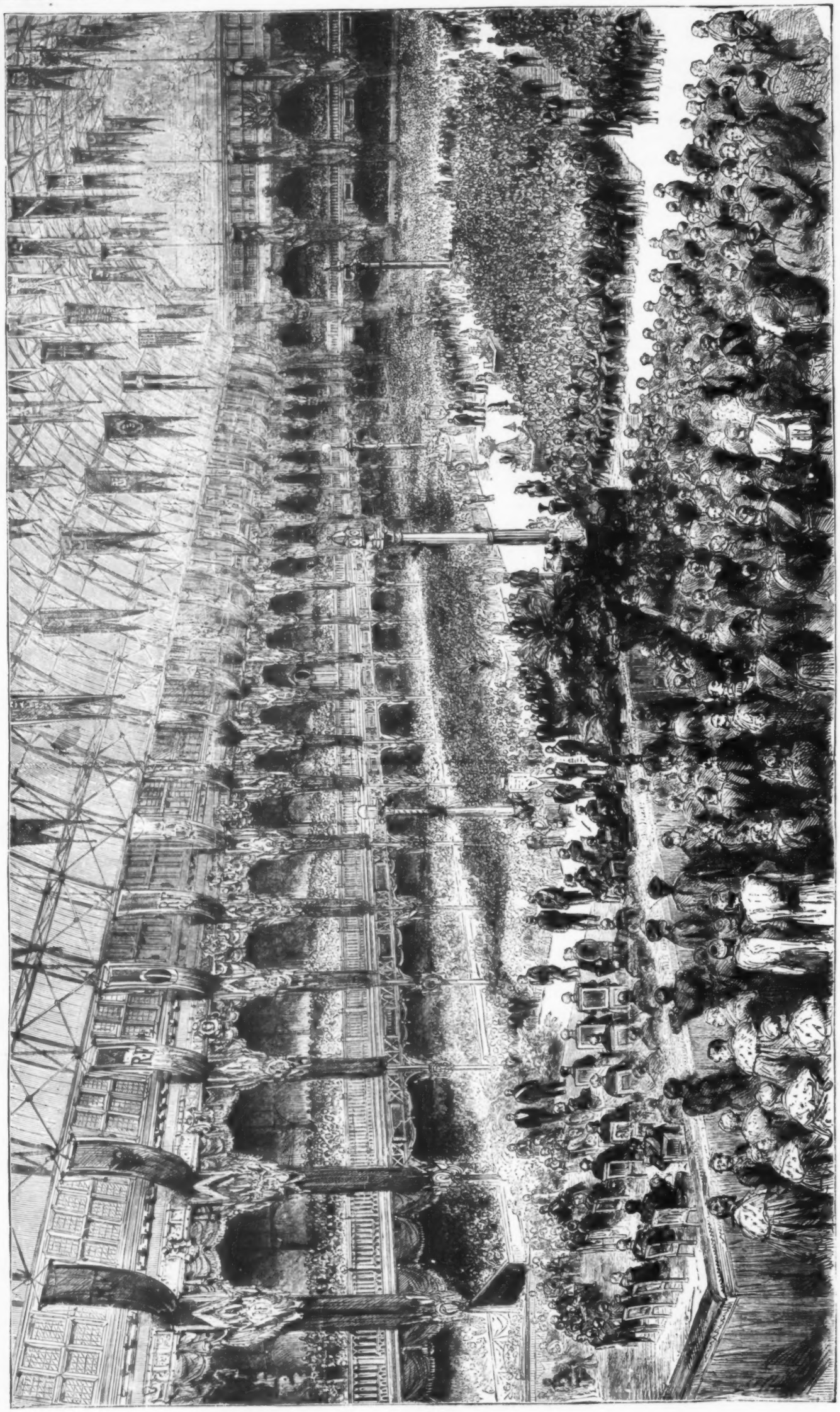
THE PARIS EXHIBITION—WATER SPOUTS FROM THE GREAT CASCADE ON THE TROCADERO.
BY E. LEGRAIN, SCULPTOR, PARIS.



THE PARIS EXHIBITION—DISTRIBUTION OF THE DIPLOMAS OF HONOR BY MARSHAL MACMAHON IN THE PALAIS DE L'INDUSTRIE.

THE PARIS EXHIBITION—AWARDING THE PRIZES.

THE crowning ceremony of the *fêtes* attending the Paris Exhibition of 1878 took place on Oct. 21st—the distribution of awards by Marshal MacMahon in the presence of some 22,000 spectators, including various princes and other distinguished foreign visitors. The Palais de l'Industrie in the Champ Elysée, where the ceremony took place, is a building all the more fitted for the occasion, as it was built for the first World's Fair ever held in Paris—that of 1855; and the large hall which was set apart for the ceremony still contains the stained-glass windows at either end depicting France convening all nations to the Exhibition, and Equity presiding over the increase of exchange. The hall had been most brilliantly decorated in red and gold, the galleries being bountifully hung with these colors, and the columns being swathed in crimson velvet, and embellished with gilded shields inscribed with "Pax," or the initials of the French Republic—"R. F." Pennons of the various countries represented at the Exhibition hung from the roof, while gigantic shields inscribed with their names were ranged round the galleries. The immense area of red velvet benches beneath also was broken by trophies representing the industrial and agricultural arts; while at one extremity an immense platform had been erected for the Marshal, his guests, the diplomatic body, the members of the Senate and the Chamber of Deputies and the chief functionaries of state. Immediately beneath the platform a space had been reserved on either side respectively for the foreign and French winners of gold medals and *prix d'honneur;* then came an inclosure for the juries, next the general mass of exhibitors, and finally the orchestra, which was composed of the bands of the Garde Republicaine and the 5th Regiment of the Line, and some twenty-three choral societies. The galleries were filled with ladies and other privileged spectators. Although the ceremony was not announced to take place until one o'clock, the stage was filled some two hours earlier, so afraid were the ticket holders lest their places should be appropriated. At a quarter to one the music struck up, the soldiers presented arms, and with M. Grévy, the President of the Chamber of Deputies, began the entry of a long line of distinguished guests, either in the regulation evening dress, or in uniforms resplendent with brilliant decorations. At one punctually Marshal MacMahon, together with the Prince of Wales and various other royal guests, appeared, and took his seat on the dais, the Prince being on his left, and the ex-King of Spain, Don Francis d'Assisi, being on his right, the Princes of Denmark and Sweden, the Duke d'Aosta, and the Count of Flanders being behind; while Madame MacMahon, with the Princess of Wales, were in a box at the side. Then ensued a picturesque international procession, formed of the regiments which had been sent over by the various nations to watch over their respective sections. These clad in their national uniforms, and bearing their country's flag, formed a most effective feature of the proceedings, as they ranged from the silk-clad Celestials, with their yellow dragon, to the United States sailors, with their stars and stripes, from the picturesquely-clad Hungarian to the burly negroes of Senegal, with a perfect Goliath of Gath for their leader. Next came a procession of groups of exhibitors, representing their various classes, also with banners, some of which are said to have cost from £800 to £1,000. After all had passed, Marshal MacMahon made a brief speech, thanking the various princes for the assistance they had rendered to the Exhibition, and congratulating France upon its unqualified success, more especially as at the time that the Exhibition was first proposed France had just passed through "severe trials," while "her industry had not escaped the effects of that vast commercial crisis which weighed on the entire world. Yet the Exhibition of 1878 has equaled, if it has not surpassed, its predecessors." The Marshal was loudly cheered on resuming his seat with mingled cries of "Vive la République!" and "Vive le Maréchal!" and then M. Teisserenc de Bort rapidly summarized the work of the Exhibition, and MM. Georges Berger and Dietz Monin, the Directors, proclaimed the names of those exhibitors who had been decorated with the Legion of Honor, and the proceedings finally closed with the announcement of the various awards, the President and Vice-Presidents of each group of jurors coming up to the dais to receive the crosses and recompenses to be distributed amongst the members of their class, amid the cheers of the assembled multitude.—*London Graphic.*

THE *Metall-Arbeiter* gives the following prescription for a perfectly safe powder for resilvering plated articles: Three parts chloride of silver, twenty parts crude tartar, and fifteen parts common salt. The materials are ground to an exceedingly fine powder and thoroughly mixed.

GLYCERINE injected into the veins of animals in large quantities—say to the one-hundredth part of their total weight—proves fatal within twenty-four hours, a result which need surprise no one.

THE GREAT MEDAL OF HONOR OF THE PARIS EXHIBITION.

THE medal of the Exhibition, of which we give an illustration below, has been designed and executed by Mr. Chaplain, who makes this branch of art a specialty. The design is the same for all grades of awards, the only difference being in the material and the size. The medal of honor for the arts and the great prize for the industrial exhibition are of gold, and are 68 millimeters in diameter; the regular gold medal is smaller, having a diameter of 50 millimeters. The bronze medals are of the same size as the silver medals, and also 68 millimeters in diameter. As far as their value is concerned, the first two of the medals are worth 750 francs; the gold medals, 280 to 300 francs; and the silver medals, 30 to 40 francs; the bronze medals possessing, of course, no intrinsic value.

From an artistic point of view, we can but admire the artist. The medal, being an elegant result of antique inspiration, shows on one side the face of a virgin, representing the Republic; the other side shows "Fame," traveling through the universe and proclaiming the name of the recipient of the award, inscribed upon a sign supported by a genius. Below is shown a view on the Trocadero and the Champ de Mars. The whole is inclosed by the name and date of the event in honor of which the medals were coined.

The English medals of 1851 and 1852 hardly could be called works of art, as they only contained the image of the Queen and the date. The French medals of 1855 and 1867 were more elaborately executed; but of all medals yet awarded on similar occasions, the medal of 1878 may be considered the most beautiful in conception and tasteful in execution. Our illustration is taken from the medal awarded to the celebrated French publishing house, Hachette & Co., for its scientific, pedagogic, and artistic publications.—*L'Illustration.*

MANUFACTURE OF HYDROGEN GAS FOR THE CAPTIVE BALLOON AT PARIS.

IN reference to the great captive balloon at Paris, our readers have been made aware that M. Giffard employs pure hydrogen for the inflation of the balloon in preference to the ordinary illuminating gas, which owing to its containing a large percentage of carbon, by which it is endowed with its photogenic properties, its specific gravity is largely increased, and therefore when inclosed in a balloon would possess a much less lifting power than hydrogen. With the gas producing apparatus which, like everything else connected with the balloon, has been specially designed by M. Giffard, the extra cost of the gas so produced over that of ordinary coal gas is more than compensated for by its superior lifting power, for as the charge to each passenger for making an ascent is 20 francs, and the balloon can make as many as three ascents per hour, each additional passenger which the balloon may be rendered capable of carrying becomes a material commercial consideration, and moreover, it must not be forgotten that the cost of illuminating gas in Paris is as much as 6s. 10d. per 1,000 cubic feet to the public, and to the corporation of the Ville de Paris is 3s. 5d.; and when it is considered that while coal gas is only 2½ times lighter than atmospheric air, pure hydrogen is between 14 and 15 times lighter, the advantages of the latter over the former for aeronautic purposes are very great indeed.

BALLOON HISTORY.

After the days of the two Montgolfiers (1783), who filled their balloons with atmospheric air expanded, and therefore rendered lighter, by being heated by a heater carried in the car, the earlier balloons were filled with common hydrogen gas, and were known as Charlières, after Professor Charles, who in 1783 suggested the employment of that gas (the still earlier fire balloons being known as Montgolfières), and it was not till the year 1836 that Mr. Green introduced the use of coal gas for filling balloons, which, until the readoption by M. Giffard of hydrogen, has been universally employed. The first balloon ascent, in which the car contained a living freight, was a "Montgolfière" or fire balloon, and ascended from Versailles on the 19th of September, 1783, in presence of King Louis XVI. and the royal family, having in its car a sheep, a duck, and a fowl, all of which reached the ground again in safety. It was also in a Montgolfière that the first ascent was made with human voyagers, and this was on the 21st of November of the same year at Paris, the aeronauts on that occasion being M. Pilâtre des Rosiers and the Marquis d'Arlandes. On the 1st of December of the same eventful year in the history of areonautics, the first hydrogen balloon or Charlière, as it was then called, rose from the Tuileries Gardens, carrying Professor Charles and his companion, M. Robert. The first coal gas balloon was the celebrated "Nassau" balloon, which in the year 1836, carried Messrs. Green, Mason, and Holland, from the Vauxhall Gardens, London, to Weilburg, in the Grand Duchy of Nassau, a distance of 500 miles, in 18 hours. From that time until the year 1867, when M. Giffard constructed his first captive hydrogen balloon, aerostats have, almost without exception, been inflated with the common coal gas manufactured for illuminating purposes.

MANUFACTURE OF HYDROGEN.

For the production of the hydrogen with which the 1867 balloon was filled, M. Giffard employed a large number of wooden casks arranged in four rows, two rows discharging their gas into one service pipe, and the other two rows into another. Each cask stood on end, and through its upper head were fixed two pipes; one, passing down to the bottom of the cask, had a funnel at the top, and served for the introduction of diluted sulphuric acid, and the other only just penetrating the head of the cask into the gas space, connected it with the service pipe mentioned above, and through another hole in the upper head, closed with a bung, could be introduced iron turnings, by the action of which upon the diluted acid the hydrogen was liberated; the two service or collecting pipes united into one, which communicated with the gas-washing apparatus, shown in Fig. 1. Entering at the nozzle, C, communicating with the tube, *b b*, which was pierced with holes, shown at *l l l l*, the gas bubbled through the water in the lower part of the vessel, passing out of the apparatus by the pipe, E. The water during the operation was continually being renewed by a stream flowing through the tube, *e*, from a tap placed above it, which was distributed by the jets, *a a a a*, so as to fall through the gas in the form of rain; at *f* was an over-flow-valve by which the waste water was carried off and directed into the waste channel, *g*. D represents a cover which could be removed for getting at the interior of the apparatus, and which was rendered gas tight by its edge dipping into the annular trough, *h h*, containing mercury. After passing through the washing apparatus the gas was conducted to the purifying apparatus, which consisted of a cylindrical vessel filled with quicklime, and from thence, after traversing a glass chamber, in which were fixed a thermometer and a hygrometer, by which its temperature and humidity were indicated, it passed into the inflation pipe leading to the balloon.

Fig. 2 represents, in sectional elevation, an apparatus designed by M. Giffard for the production of hydrogen gas by a very ingenious and economical process, and without the use of any liquid whatever. This process is founded (1) upon the property which carbonic oxide possesses when heated of reducing native oxide of iron or ore, the carbonic oxide combining with the oxygen of the ore to form carbonic acid, at the same time reducing the iron to the metallic state, and (2) upon the property which the metallic iron so produced possesses of decomposing steam passed over it. In this case the oxygen of the steam combines with the iron, reconverting it into oxide, and the hydrogen of the aqueous vapor is set free. The special economy of the process consists in the fact that the iron oxide can be used over and over again, the first operation reducing it to the metallic state, and the second restoring the oxygen and bringing it back to its original condition ready for the first operation to be repeated again. Referring to Fig. 2, the apparatus consists of two cylindrical stoves, each lined with firebrick, one of which, C, is filled with broken up coke, and the other, marked M, with native oxide of iron. The form of the stoves is such that the material when fed in through the openings, A and K, will always leave air spaces at the points marked *a a b b, a' a' b' b'*. The coke at the bottom of the stove, C, having been ignited, an air blast is admitted through the tuyeres, T and T', and a vigorous combustion ensues, carbonic oxide being formed which passes out through the tube, B, into the filtering apparatus, R, which is a cylindrical vessel filled with small lumps of fireclay or other incombustible matter, by which solid particles, such as cinders, dust, and other mechanical impurities blown through the fire by the blast are abstracted from the gas, which is then conducted by the pipe, D, to the lower part of the stove, M, where it comes into contact with the iron oxide, converting the surface of each lump in its passage through the chamber into metallic iron by seizing the oxygen which had previously been in combination with the iron, and thereby converting itself into carbonic acid, which escapes by the flue, F, into the chimney. It is not necessary to apply any other heat to the chamber, M, than that caused by the heated gas from the coke chamber entering into combination with the oxygen of the ore.

When enough of the ore has been reduced the first part of the process is complete, the valves, S and S', are then closed, and a stream of steam is passed through the mass of heated iron, entering by the pipe, E. During this passage the steam is decomposed into oxygen and hydrogen, the former combines with the iron to reconvert it into oxide, and the latter escapes by the tube, H, from which it is led to the various portions of apparatus by which it is cooled and purified. M. Giffard states that by this process, the cost of producing hydrogen gas is no greater than five centimes per cubic meter, which is roughly at the rate of about 3½ cubic feet for one farthing. We are not aware that this apparatus was ever employed by M. Giffard for the inflation of a balloon, but it is important to mention it in this place as a link in the history chain of that portion of areonautics which has especial reference to the production of hydrogen gas, and as a record

THE GREAT MEDAL OF HONOR AT THE PARIS EXHIBITION.

of the contributions of M. Giffard to that department of science

The first elaborate apparatus for the production of hydrogen gas, and from which was developed the apparatus employed for filling the present captive balloon at Paris, was designed by and constructed for M. Giffard in 1877. It is represented in sectional elevation in Fig. 3 and in plan in Fig. 4. A is the vessel in which the gas is generated by the action of iron turnings upon diluted sulphuric acid, and consists of a vertical cylinder lined throughout with sheet lead, having below a false bottom pierced with a number of holes through which the diluted acid rises, being admitted beneath; the iron turnings lie upon this perforated

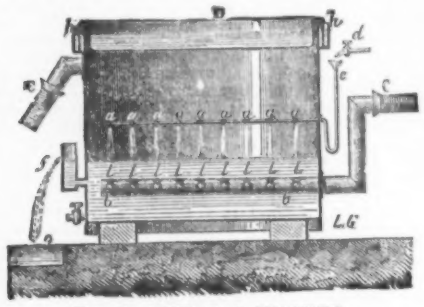


FIG. 1.—THE GAS WASHER.

plate, and are introduced into the apparatus by the inclined shoot, B, which discharges them into the hopper, C, which is fitted with a cover into a hydraulic joint, and which is raised and lowered by means of a rope passing over the pulley, D. The apparatus by which the sulphuric acid is mixed with the requisite proportion of water is most ingenious. O is a rectangular reservoir into which the strong acid is run out of the casks in which it is delivered; from this reservoir it is lifted by a pump, P, into the upper cylindrical vessel, Q, in which is a float with a divided stem by which the level of the acid within the vessel is indicated. At the bottom of this vessel is an outlet pipe, opened and shut by a ball-valve floating within the small rectangular cistern, *b*. In the same manner water is admitted into a similar cistern, *b'*, also provided with a ball-cock. From the cistern, *b*, the acid is conveyed by means of a lead pipe to the vessel, *c*, and the water is conducted from the cistern, *b'*, to the vessel, *c'*, both pipes being provided with screw valves by which the amount of flow can be regulated. Out of *c* and *c'*, the acid and water pour in two continuous streams into a pair of siphon tubes by which they are conducted into the mixing chamber, E, which is providing with intercepting shelves by which they are, in their descent, dashed from side to side and intimately mixed. The mixing apparatus is shown in an enlarged sketch in Fig. 5. A very ingenious contrivance is adopted for cutting off the supply of acid the moment that the supply of water from any cause runs short.

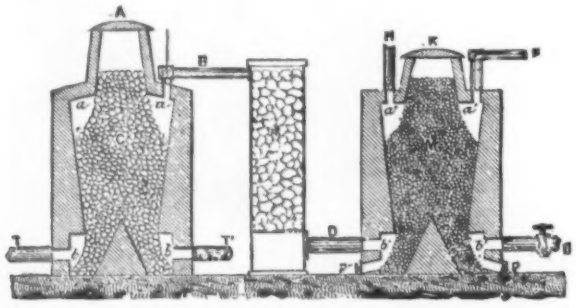


FIG. 2.—THE HYDROGEN RETORTS.

This arrangement consists of extending the ball lever in the acid tank so as to produce a tail-piece projecting beyond the tank; the ball lever of the water-tank is also extended so as to overlap the tail-piece of the acid lever upon which it rests, a little roller being attached to its extremity to reduce friction. Should, therefore, the supply of water be deficient the water-cistern will empty itself, the ball will sink, and in doing so its prolonged lever will press down the tail-piece of the acid lever and shut off the acid supply, but on the re-establishment of the water supply the ball will rise and the two valves will again be independent of each other.

From the mixer, E, the diluted acid is conducted to the bottom of the generator, and after passing through the perforated diaphragm is brought under the influence of the action of the iron turnings. The hydrogen thereby liberated passes off by the tube, G, while the neutral solution of iron

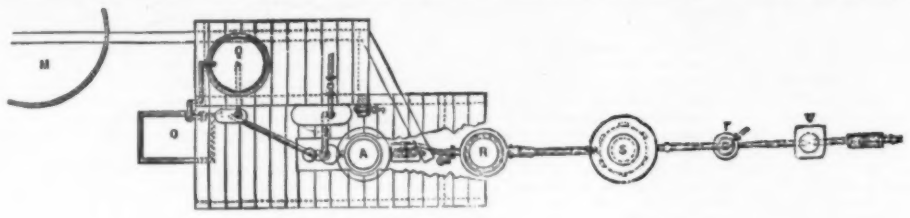


FIG. 4.

sulphate, the result of the reaction, is carried off by the U-tube, H, and piping, L L L, into a receptacle, M, placed to receive it.

The hydrogen from the generator, escaping by the tube, G, passes into the washing apparatus, R, which is somewhat similar to the earlier apparatus we have described, and which is figured in Fig. 1. It consists of a perforated coiled tube immersed in a chamber half filled with water, and through which the gas escapes by bubbling up through the water into the upper part of the chamber, where it meets a continual spray produced by fine jets of water falling from a perforated water-tube above. From the washing apparatus the gas is led into the desiccator or drying apparatus, S, which consists of a cylindrical chamber filled with quicklime; the gas enters below this chamber, passes through the lime, and out of the apparatus by the tube, K, at the top of the cylinder. In its passage through the quicklime, the hydrogen is completely robbed of all aqueous vapor on account of the affinity of that substance for water, and at the same time all traces of acid which survive the process of washing are removed. By means of a differential pressure-gauge placed at *n*, any accumulation of pressure, or indeed any difference of pressure between the upper and lower portions of the cylindrical vessel, is at once indicated.

Having been washed, dried, and freed from acid, the gas requires only to be cooled, measured, and tested before it is fit for use. The cooling apparatus, or refrigerator, which is shown at T, consists of a vertical tube surrounded by a cold water jacket, the contents of which are kept in continual circulation by a stream entering at the bottom of the apparatus and escaping at the top; the gas enters at the top by the tube, K, and passes out below by pipe, Y; thus the water and the gas circulate in opposite directions, so that the latter as it becomes cooled is continually meeting colder water. From the refrigerator the gas passes by the tube, Y, into the apparatus, V, which is shown in detail in Fig. 6. Here the gas is tested both for temperature and for humidity, and its flow is measured by a simple and ingenious contrivance.

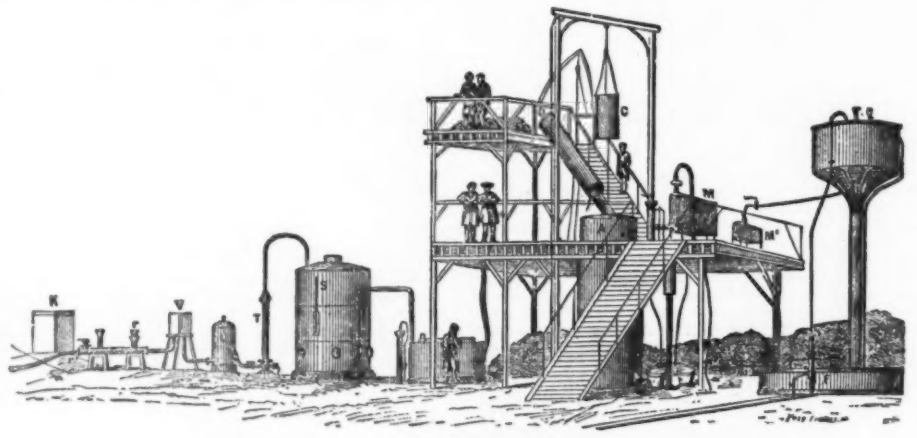


FIG. 7.—GENERAL VIEW OF THE PRESENT GAS APPARATUS.

The temperature of the gas is indicated by an ordinary mercurial thermometer, and its humidity by a Saussure's hygrometer, the indications of which are brought about by the lengthening or shortening of a hair under the influence of variations of moisture. Both these instruments, as well as the meter, are inclosed in the cylindrical glass case, V. The instrument for measuring the quantity of gas passing into the inflation pipe consists of a large vertical tube of copper, in the side of which is cut a fine vertical slit. Within this tube slides freely a very light hollow cylindrical valve, S,

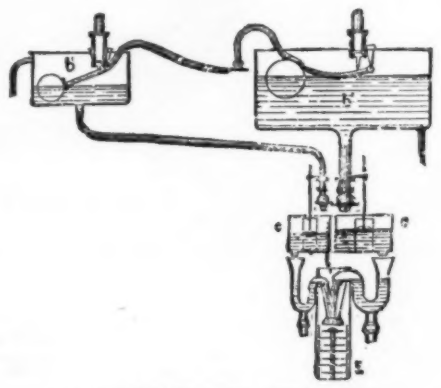


FIG. 5.—THE MIXING APPARATUS.

which is lifted by the gas within the tube to a height at which the area of that portion of the slit which is uncovered by the valve is exactly proportional to the flow of the gas; the greater the quantity of the gas the higher the valve is lifted, and consequently a greater length of slit is uncovered through which the gas can escape into the glass chamber, V. The flexible pipe leading to the balloon, and by which it is inflated, is attached to the cock, *r* (Fig. 3). The

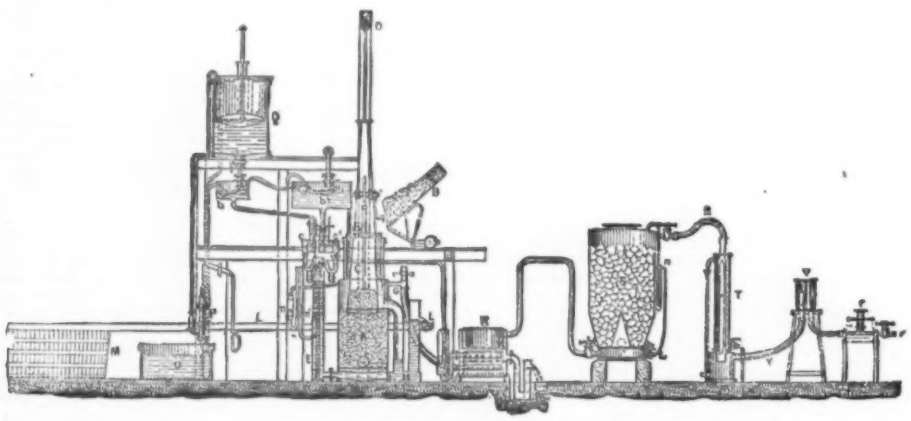


FIG. 3.—GIFFARD'S ORIGINAL APPARATUS.

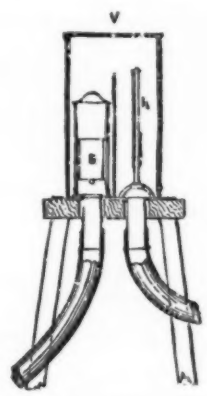
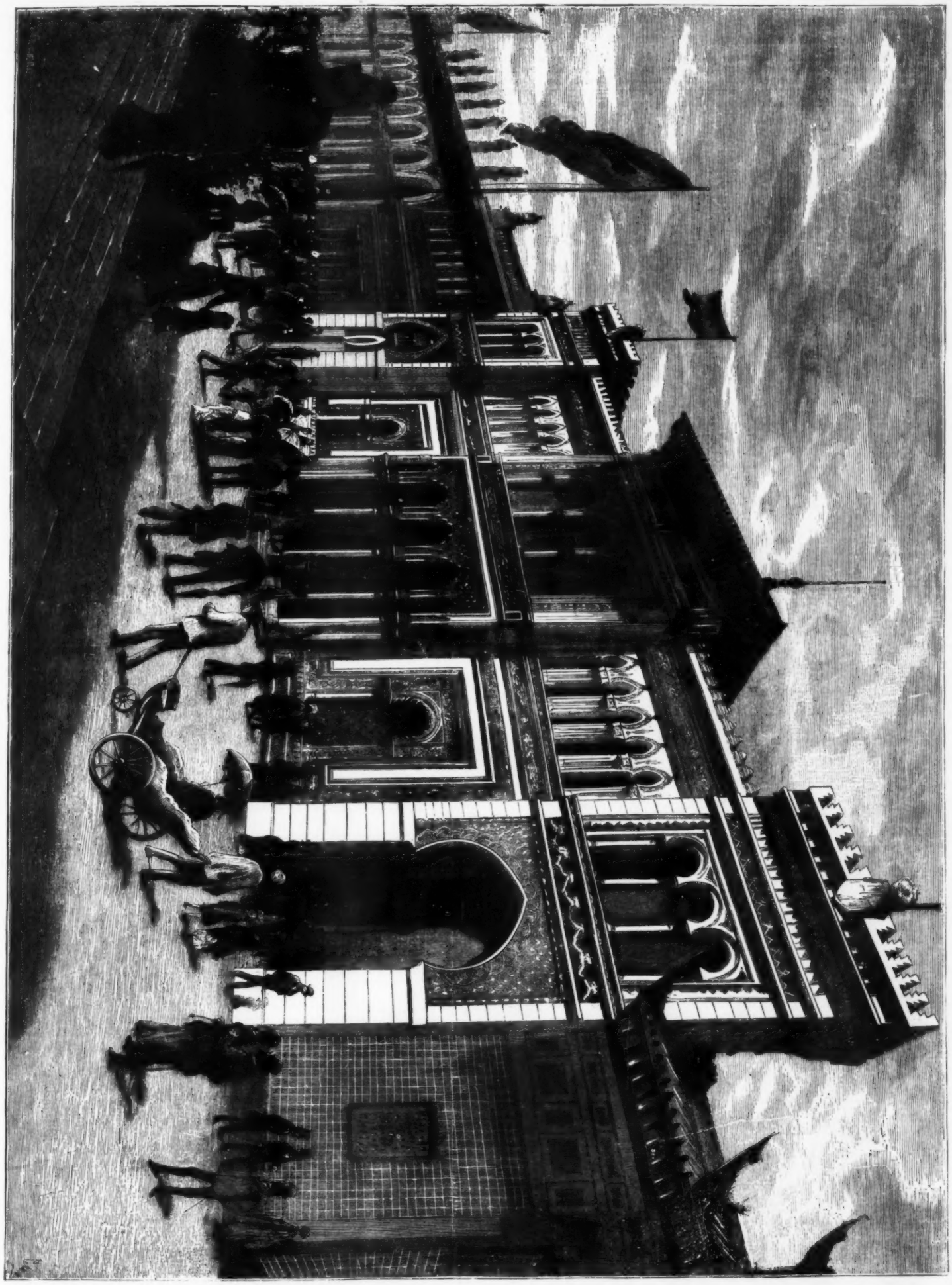


FIG. 6.—GAS TESTING APPARATUS.

THE PARIS EXHIBITION—MANUFACTURE OF HYDROGEN GAS FOR THE CAPTIVE BALLOON.



THE PARIS EXHIBITION—FACADE OF THE SPANISH SECTION.

small cock, r', to the extreme right of this figure, is for taking samples of the gas for testing and other experimental purposes.

The above apparatus for the preparation of hydrogen gas was that designed and employed by M. Giffard for the inflation of his balloon of 1877, and it has been used on several occasions, unnecessary to mention here, for filling other balloons.

Fig. 7 is a general view of the gas-generating apparatus by which the present captive balloon at Paris was inflated. It is identical in principle with the apparatus last described, and differs from it only in size and in some of its details, which have been carried out with great perfection. A is the generator proper in which the acid solution is brought into contact with the iron turnings, introduced into it through the inclined shoot, D. The sulphuric acid is first run off out of the casks in which it is brought into the acid-tank, K, to the extreme left of the figure, finding its way by means of an underground pipe into a reservoir, K. From this it is lifted by a Giffard steam injector into the upper reservoir, Q. M and M′ are the water and acid tanks respectively, and they are fitted with similar ballcock arrangements to those shown in Fig. 5, as well as with a similar mixing apparatus.

The gas on leaving the generator, A, passes through the washing apparatus, R, thence into the purifying desiccator, S, which is filled with quicklime, through the refrigerator, T, into the cylindrical vessel, U, which filters it of all finely divided particles of lime. V is the measuring apparatus, which contains also the thermometric and hygrometric instruments; r^1 is the tap leading to the balloon pipe, and r is a cock for taking samples. The apparatus is also provided with a safety valve, by which any undue pressure is relieved, and there are throughout the apparatus many points of refinement to which we have not space to refer in this notice.

The apparatus is capable of producing hydrogen gas as pure as it is possible to be obtained commercially, at the rate of nearly 80,000 cubic feet per hour, and in the inflation of this great captive balloon, now installed in the Place du Carrousel du Louvre, no less than 190 tons weight of sulphuric acid and 80 tons of iron turnings were consumed in the apparatus above described, for the production of the hydrogen gas by which it is endowed with its great lifting power.—*Engineering.*

ELECTRICAL APPARATUS AT THE PARIS EXHIBITION.

THE AUTOGRAPH TELEGRAPH.

In the French annex is an instrument shown by M. D'Arlingcourt, described as the autographique telegraph. This instrument is designed principally to be used for military purposes, and, from what we have seen of its action, we have no doubt that in many circumstances it will prove exceedingly valuable. Hitherto the commander-in-chief has been compelled to send an aide-de-camp to give directions to this or that subordinate. The space occupied by the large armies of the present day is the cause of delay frequently occurring before such dispatches can arrive at their destination. There is, too, the danger of the messenger being killed or taken prisoner; in the latter case the dispatches and plans carried by him may become the property of the enemy and be used against his comrades. The ordinary telegraphic apparatus has become a necessary part of the equipment of every army, but the Morse instrument, although of great use, is not capable of doing everything. It is hardly to be expected that commanders and officers are able to send and read by it, though why this does not form part of their education we cannot say. However, it is generally necessary to employ manipulators, and one can well understand that at times it is dangerous to have a secret held, say, by two officers and two manipulators. The officers would prefer abso-

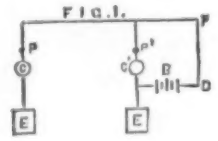
THE PARIS EXHIBITION—THE MONACO PAVILION, EXTERIOR AND INTERIOR.

THE PARIS EXHIBITION.

1. FACADE OF THE PORTUGUESE SECTION. 2. FACADE OF THE DUCHY OF LUXEMBURG. 3. GRAND BEER BARREL IN THE HUNGARIAN SECTION; CAPACITY 100,000 LITERS. 4. FACADE OF THE NORWEGIAN SECTION. 5. BAZAAR OF TUNIS. 6. FACADE OF THE ITALIAN SECTION.

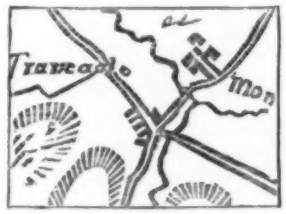
lute secrecy. Again, plans or diagrams may be wanted in the midst of an engagement, and, however valuable the Morse instrument, it will not send a map from one point to another. Now this is just what the apparatus of M. D'Arlingcourt will do. It gives absolute secrecy, and will send maps or plans or anything of the kind required. The apparatus is very simple, and occupies little space. It can be placed in a case 75 × 50 × 50 centimeters. This case contains the apparatus proper—a relay, a bell, a galvanometer, a lightning conductor, a small Morse instrument, the necessary paper, rule, scissors, and ink. The following diagram, Fig. 1, which, however, is not intended to represent the apparatus, but to show the manner in which it acts, will aid in understanding its mode of working. At the sending station and at the receiving station are similar cylinders driven synchronously by means of a clockwork arrangement. Let C C in the diagram represent the two cylinders, P P, two pla-

FIG. 1.

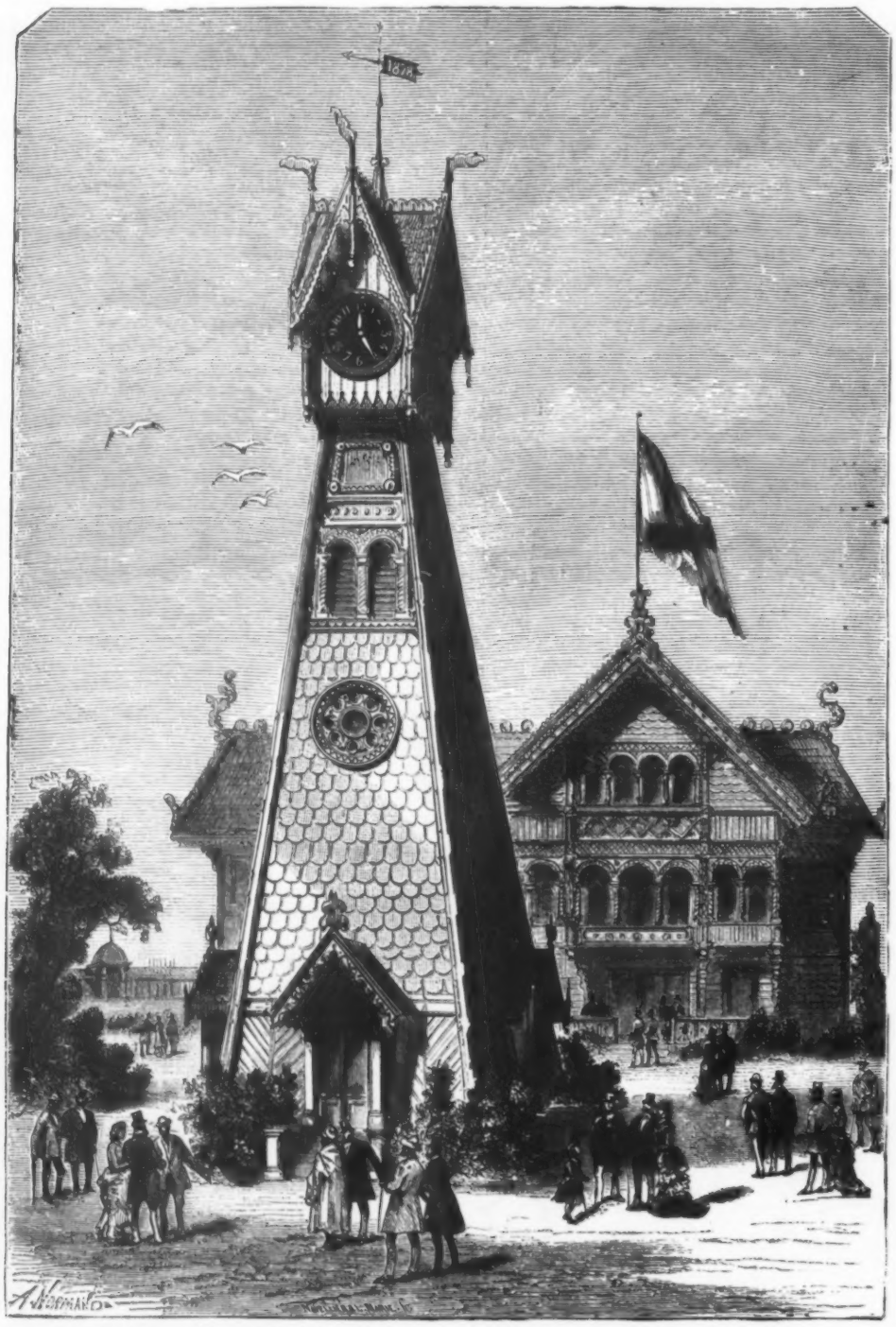


tinum wires or fingers touching the surface of the cylinders and connected to the line wire. These platinum points are adjusted to move easily over the surface. Cylinder C at the sending station is connected with the battery, B. The dispatch or plan to be sent is written with greasy ink on a piece of foil paper, which fits accurately the circumference of the cylinder, C. The inky surface is non-conducting, the metallic foil is conducting. A lateral motion is given to the cylinders by means of the driving gear. Having then our dispatch ready, it is fitted on the cylinder, the apparatus set in motion, the two cylinders of course acting precisely alike. The platinum point in due course passes over the whole surface of the cylinder, the time required to do this depending on the size and velocity of the cylinder. The current from the battery whenever the platinum point touches the metallic foil goes through the short circuit, B D F C, but whenever the point touches the non-conducting surface the circuit is compelled to take a course through the line wire, and so to the other cylinder. Fitted to the second cylinder, C, is a piece of chemically-prepared paper, and whenever the current passes a blue mark is made. Now as the current passes to C whenever the point, P, comes into contact with the ink on C, we get of necessity a *fac-simile* of the original message, map, or plan. The accompanying diagram, Fig. 2, is a specimen of the message as received. It will at once be seen that the intervention of a third person is not required. If the sender's writing or drawing is legible in the original it will be just as legible in the copy, and any one who can see and read will understand. Forgery, or the tale "that some one has blundered," is almost impossible with the use of the Autographic Telegraph. The French military au-

Fig. 2.



thorities, when they heard of the invention, were so eager to try its merits, that although M. D'Arlingcourt was very ill, they had an apparatus fitted up between the sick room and the Camp de Saint Maur. The connecting wire was the ordinary subterranean wire which traverses Paris, and although the inductive action was great, the experiment was perfectly successful. M. Trouvé has also a telegraphic apparatus designed for military purposes. A few words will suffice for its description. A soldier carries on a reel some thousand yards or so of insulated wire, which unwinds as he walks along. A small sending and receiving instrument in his hands and in the hands of the officer or colleague, together with a small battery, constitutes the apparatus.



THE PARIS EXHIBITION—THE SCANDINAVIAN CLOCK TOWER.

ELECTRIC ENGRAVING MACHINE.

We may here mention another and more important modification of Caselli's invention than that of M. D'Arlingcourt—more important, at any rate, when considered, as we ought to consider every phase of scientific progress, in its connection with the wants of everyday life. We did not see this instrument at work at the Exhibition, nor is it altogether new. Several of the machines we refer to were shown at work at a scientific *soirée* at the Conservatoire des Arts et Métiers. These machines would be expensive additions to the workshop, unless a large number of copies of one design was required. The electro-magnetic engraving machine will be easily understood from the previous description. Instead of a cylinder covered with tinfoil, a large cylinder, having a circumference equal in surface area to the

FIG. 4.

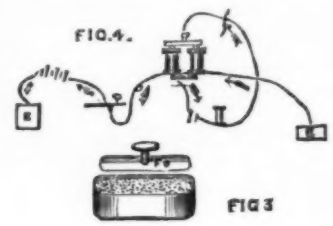


FIG 3

utensil to be engraved, is used. The design to be reproduced is carefully inlaid in brass upon the surface of the cylinder. A good conducting material is used to make the cylinder. An electro-magnet at the working end acts or does not act upon the graving tool, allowing it to cut or not as the current passes through what may not inappropriately be termed the line wire, which contains the electro-magnet, or a short circuit. Whenever the point touching the revolving cylinder comes into contact with the brass, the graving tool is withdrawn, and ultimately the whole surface, except that represented by the brass design, is cut, and the design stands out in relief on the tray or on the other object worked. A little ingenuity spent on the machine would make it work quite automatically, so that one man could look after several of the machines; in fact, we see no great difficulty in connecting several graving tools with one cylinder, and thus reproducing the design three or four times at once.

ELECTRIC FIRE ALARM.

Close to the stall of M. D'Arlingcourt is that of M. Leblan, who shows one of the neatest automatic fire indicators we have ever seen. Before describing it, we may remind our readers that quite recently the system of fire alarms so successfully and so extensively adopted in America and in some parts of the Continent has been imported into London. The Exchange Telegraph Company in Cornhill shows some very good fire indicators, so sensitive that the change of temperature caused by the warm breath impinging on the instrument will set the bell ringing in connection with it. The apparatus which M. Leblan has devised is based upon the property which certain bodies, such as felt and wool, possess of acting as good conductors of heat when the heat rays vary by insensible degrees, while offering resistance to quick changes of temperature, as those caused by instantaneous combustion. M. Leblan is in fact the inventor of a new differential thermometer. In its construction he employs zinc, which is a metal having a high coefficient of expansion. The instrument consists of two strong plates of zinc cut from the same sheet and identical as to size, 0·6 meter long by 0·05 meter wide, placed parallel on a wooden pedestal; the ends on one side are firmly fixed, but on the other capable of moving freely. One of the plates is uncovered, and its end free to carry a platinum spring. A binding screw is placed opposite, fixed by an insulated body to the second bar, which is covered throughout its length with a sheath of cloth or left.

The screw is connected with one of the poles of a battery; the two plates are connected to the other pole, and in the circuit is placed a bell at some point where its sound can easily be heard by the inmates whenever it happens to be sounded. The action of this apparatus is easily seen. If the amount of heat received by the plates is gradual, the expansion of each is equal and the relative position of the platinum spring and contact screw is maintained; but should the development of heat be sudden, the uncovered plate expands at a greater rate than the other, forcing the spring against the screw, thus completing the circuit, when a current at once actuates the bell and gives the alarm.

A MONSTER CELL.

Porous jars of all sizes are shown by M. Frion, which we should pass by unnoticed except that one is a giant in its way, being one meter in height, and the same in circumference. We should not care to have many elements in use containing such porous jars as these.

NEW RELAY.

M. Thomasi, of 50, Avenue du Wagram, shows a new relay which he claims to be sufficiently sensitive to be used in long cables. That it is exceedingly sensitive we do not doubt, but it must undergo an exhaustive trial on a longer cable before we place much confidence in it. We in England are simply a head, shoulders, and half a body before all other nations in cable work, and we are accustomed to swear by the magnificent instruments of Sir W. Thomson. A short cable is not a good test, and many relays which work well when land lines are in question, are killed when cables and inductive action are brought into play. We may be wrong as regards this relay, and shall wait with some impatience the results of future experiments. The electro-magnet of this relay has a resemblance to that which Faraday employed during his experiments in the rotation of polarized light under the influence of magnetism, only the bar connecting the two opposite poles is also an electro-magnet, and it is between the poles of this electro-magnet that the bar is placed which acts upon the relay contacts. This bar—or rather this magnetic system, because it consists of two parallel bars—is small and short, so as not to be greater than the diameter of the polar extremities of the electro-magnet; each of the magnets pivoted upon its center carries a small cleat—*taquet*—intended by concussion to aid in breaking contact, and so render the movements of the system more speedy. Under normal conditions, the bars are held equatorially to the electro-magnet by a fixed magnet, but when the current passes through the coils of the electro-magnet, each of the poles of the latter acts upon the magnetic system, and tends to cause it to move in one or

other direction according to the direction of the current through the coils of the electro-magnet, the result being that contact is made and the local battery brought into the circuit to actuate the instrument connected with the relay.

EDISON'S RELAY.

This relay has been successfully tried over a line 5,000 kilos long, of which 300 consisted of subterranean wire. Speaking of relays, it will not do to overlook Edison's. This gentleman makes use of carbon, a substance of which he seems very fond. He takes a box, Fig. 3, with sides made of a non-conducting material, the bottom of soft iron, and fitted with a lid of the same metal. He nearly fills this box with powdered carbon, and on the carbon puts the lid; the box is then used as the armature of an electro-magnet. Now when a current passes through the coils of the electro-magnet, which connect with the line wire, Fig. 4, the iron lid is attracted, and the carbon is compressed. The local circuit contains the relay box. When no current passes in the line the resistance of the carbon is so great that the small local current does not affect the instrument, but under compression the carbon conducts better, the resistance is lessened, and the current increases sufficiently to actuate the instruments.

OCEAN TELEGRAPH CABLES.

Speaking of relays leads us to think of cables. There is, however, not much interest to be derived from seeing cables, as nothing very new is shown. In the English department the Telegraph Construction and Maintenance Company and Mr. R. S. Newall show specimens. The former are probably the largest cable manufacturers in the world. Still a fair display is found in the French annex. The latest improvement in cable manufacture is the protection of the cable from the teredo by a brass tape wound spirally round the insulated core. M. Barron exhibits a roll of cable used in Paris after his design, which after sixteen years' service is as good as it was when first laid. The question of the life of a cable is unsolved, but we incline to the opinion that under favorable circumstances there is no reason why a cable should not last for 100 or 200 years.

IRON TELEGRAPH POLES.

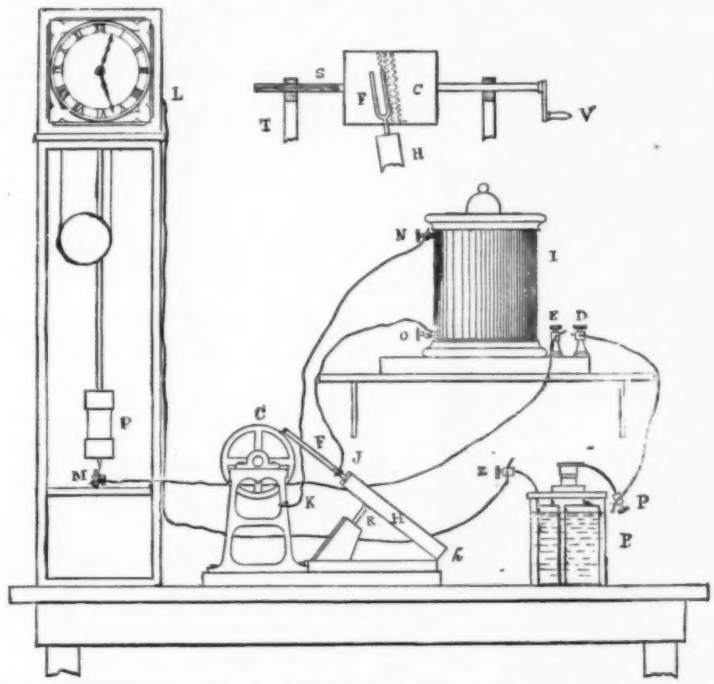
Passing from cables to aerial lines, there is at the entrance to the French annex a fine exhibit of iron telegraph posts, shown by the French Telegraph Administration, MM. Vauzelle et Fils and M. Desgoffe. In some countries wooden poles cannot be used. Either want of wooded tracts from whence to obtain poles, chemical conditions, or ravages of insects, or some or all of these combined, serve to prevent the use of wood. The iron poles shown are of varied designs, from light poles to carry one wire to heavy poles to stand on the banks of rivers, nearly 50 ft. high, constructed to carry from 40 to 50 wires. The lighter poles are constructed of T and H angle iron, or of iron strips wound spirally inside three uprights. The heavier poles are of angle iron of different kinds. Some of these poles are fitted with boxes, which will hold tools, etc., necessary for the repair of the line, or instruments for testing purposes. The arrangements in use in one or two cases are so made that the boxes contain contact screws for the junction of aerial and subterranean wires. It has been suggested that lighter and stronger poles at a less cost might be made by using steel. It is true that as yet steel is not so widely used as it will be in future, and it may be found that the suggestion is of practical value. We should be glad to have statistics relating to the action of lightning upon lines constructed with iron poles. Is it found that less damage is done, or more?—*The Engineer.*

AN ELECTRIC FREE-PENDULUM REGULATOR.

AT the present day the exigencies of life bid us seek some means by which we may not only obtain time which shall be correct, but which shall also be exactly the same in all the clocks of a city, or of a large establishment. The various solutions of the question hitherto proposed take as a starting point—as a regulator—the common clock, with an electric contact for communicating the hour to the different dials. Whatever good results have thus been obtained are due solely to the perfect working of regulators so complicated in their construction as to make them of enormous price, as well as very expensive to keep in repair. A regulator put upon the market at a very moderate price would necessarily be of too faulty a construction to assure a sale that would prove satisfactory to the purchaser.

M. Charles Tahier, in his electric clock exhibited at the Paris Exhibition, does away with all of this complicated motive system of wheels, etc.; and has completely solved the problem in a very different manner by constructing a genuine *electric regulator*, remarkable alike for its ingenuity, its simplicity, its accuracy, the ease with which it is regulated, and for its extremely moderate price.

This regulator is a simple pendulum, *entirely free*, formed of a rod of firwood (thereby dispensing with a compensation) and of a regulating ball of 40 pounds weight. It is hung from a suspension point, and regularly beats the seconds. If a like pendulum could preserve its impulse, its oscillations, always of equal length, would measure time perfectly; but the resistance of the air and that of the point of suspension would at length stop it. To restore the movement that such obstacles tend to destroy, M. Tahier uses a very simple method, which constitutes the *freest kind of an escapement.* A piece of soft iron, alternately raised, then dropped, by an electro-magnet, gives by its weight, every time it falls, the necessary impulse to the pendulum. This lever of soft iron is placed horizontally to the left and a little beneath the point of suspension; it is pivoted at the end most distant from the pendulum; the other extremity, near the pendulum, terminates in a copper tooth. The pendulum rod carries on its face a horizontal crosspiece of steel, the left extremity of which, highly tempered, is finished off into an inclined plane. Above the soft iron lever is an electro-magnet able to attract it, and through which passes the current from a battery. As long as the current is passing, the lever, attracted by the magnet, remains suspended; but when the current is interrupted the lever drops, and its extremity strikes and slides on the inclined plane of the crosspiece, thus restoring to the pendulum the motion that it was gradually losing. The means by which the opening and closing of the current is effected is extremely simple. A detent spring fixed to platinum, by an isolating piece, at a little distance beneath the suspension point of the pendulum, rests on a thin plate of platinum. It is so adjusted that it may be caught by a lifter provided with an isolating extremity of agate, and fixed to the rod of the pendulum. When the latter begins to oscillate from left to right, this lifter hooks on to the detent and raises it, thus suddenly breaking the current. Then the soft iron lever, which is being held up by the electro-magnet, falls and slides on the crosspiece of the pendulum, and by its fall gives the latter a slight impulse—always the same, for it is always the same weight falling from the same height. But immediately afterward, the detent, being set free by the lifter, springs back to its place; the current again flows, and the lever, attracted by the electro-magnet, remains suspended until a fresh break takes place. The pendulum finishes the rest of the arc from left to right, in absolute freedom, for it touches nothing at all. When it returns from right to left it is free just the same until the moment when the lifter meets the little spring of the detent, which bends, so that the current is not broken. The lever always remains suspended until the moment when the oscillation from left to right has again begun, when it falls again on the crosspiece to give a new impulse, and so on indefinitely. The different parts being properly regulated by an adjusting screw, the movement will continue as long as the battery works. By means of the mechanism described the current is opened and closed at regular



NEW ELECTRIC FREE-PENDULUM REGULATOR, FOR COMMUNICATING TIME TO ALL THE CLOCKS OF A CITY.

periods, and passes every two seconds through the wire which is connected with the different dials. The latter are common electric dials furnished with an electro-magnet, and divided into minutes; the hand of the dial will make 30 movements regularly every minute.

The advantages of this new system are easy to comprehend: the pendulum, having its movement entirely free, and its length never appreciably varying, always beats the seconds with exactness, since it is always the same weight falling from the same height which gives the pendulum its impulse, and no variation in the strength of the battery can have any influence on the regularity of the motion. The pendulum governs all the dials with which it is in communication infallibly and uniformly. This system may be easily adapted to any belfry clock, or to any good regulator. The annexed figures give the details of M. Tahier's invention.

THE POLLARD TELEPHONE.

The *Ingenieur Universel* says that on the 26th of September, M. du Moncel, who is so well known as an authority in matters pertaining to electricity, made an experiment in his drawing-room, at Paris, that was as curious as any that have been performed since the invention of the telephone and phonograph. This experiment, which took place in the presence of ten guests, was as follows:

Placing upon a table a few sheets of paper torn from a book, M. du Moncel put between the leaves some sheets of tin foil, so as to form what is known in physics as an "elementary condenser." He then connected the paper with the wires of a telephone, which was stationed in a distant apartment, informing his company that he had placed an induction coil in the circuit. Everything being in readiness, somebody sang in the telephone, when the persons in the drawing room were surprised and startled to hear the paper sing in a very loud tone, and with a power much greater than that obtained by means of the receiver of any telephone known. The experiment was repeated ten times with the same results, and amidst the applause of all present. The device is due to M. Pollard, a naval officer, well known for his telephonic researches, and is the outcome of the "singing telephone" invented by Varley before 1870, but which was never a success.

ONE SOLUTION OF THE LABOR PROBLEM.

IN a case of great industrial and financial success, with which we were personally familiar, where all the adjacent country showed decline and failure in the same lines of manufacture, a charming village grew up around the works of two brothers, whose rule was that no employé could count on a re-engagement at the end of the year unless he could show that he was richer than when the year began, due allowance being made for sickness and other misfortunes. If a man was not industrious and thrifty for his own sake and for the good of his family, it was assumed that he would not be a profitable hand to employ, and experience justified the assumption. Under the working of this rule the firm could afford to pay, and did pay, higher wages than their neighbors, because their workmen were better, the steadiness and careful working that came with integrity and thrift having a money value not less than mechanical skill. The attraction of superior wages and the advantage of living in a prosperous community naturally drew to that place the most desirable workmen of all that region, and the works were carried on at a profit, though neighboring establishments, employing inferior men, went to the wall. Very likely our manufacturing friends could furnish numerous instances of a similar sort.

A striking illustration comes from Ireland. A correspondent of *Land and Water* has been visiting what he calls a model Irish town, a practical Utopia, "standing out like a gem in this somber and commonplace world."

The town described is Bessbrook, the seat of the linen factory of the Richardsons; and, though larger than many an English county town, it contains "no public, no police, and no pawn shop." Bessbrook was founded thirty-five years ago by the Richardson brothers, and the elder, Mr. John G. Richardson, still lives to enjoy the fruits of his philanthropic labors. Over 3,000 people are employed in the mills of the company, and $350,000 are annually paid as wages. The correspondent describes the town as lying under the shadow of the great works, as of old the homes of the retainers lay outside the feudal fortresses. "In the quiet forenoon, when most of the inhabitants were at work, the streets have a silent and deserted appearance. The houses are built to accommodate one family, and are all of uniform size and appearance. Occasionally, and more especially in the triangular market place, shop windows relieve the somewhat monotonous appearance, and occasionally some building of larger size denotes its public character. No men were lounging at the street corners, no women were gossiping in the doorways, and few children were disporting themselves in the gutter. Before most of the houses was a small plat of ground, and wherever this ground was it showed evidence of care and culture. To the north of the town is a wide acreage of garden ground, each house having a proportionate space belonging to it. Do not imagine that the people here lead a humdrum existence. I am assured that there are no jollier lot of fellows during their hours of relaxation; they had plenty of amusement, but if they wanted beer they had to go abroad to get it. They are not all total abstainers, and they occasionally did go to Newry, some two and a half miles off, and perhaps brought back more than they could conveniently carry, but this is the exception, and when once they found their way to Bessbrook again, they met with such a reception from their fellow townsmen that constrained them not to repeat the experiment, for drinking is not in fashion here. There is a large library, with reading and lecture rooms attached. The dispensary and the schools are both wooden buildings, and the resident doctor attached to the former is paid by the firm. Each religious creed has its own place of worship, built and supported by its members. I was surprised at the size of some of these, especially those situated on Divinity Hill. The Quaker meeting house is prettily situated in the midst of the beautiful shrubberies and ornamental grounds which partially surround the works. The famous little Camlough river, of unambitious size, yet of enormous value to the manufacturers in this district, flows through these groves, and being formed into occasional pools, forms with the thick foliage around it quite a pretty picture."

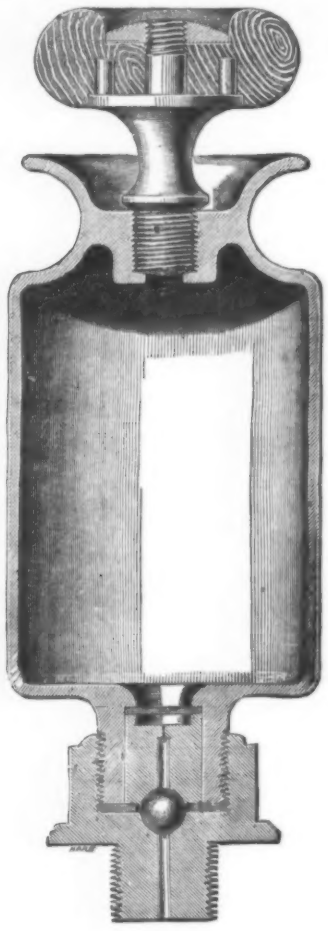
The founder's plan involved the formation of a family community of his working people; and as most of the operatives in the mills are women other occupation had to be found for the men. The result has been the development of the finest gray granite quarry in Ireland, about one mile from Bessbrook.

The correspondent is confident that such another combination of model town and mighty mill cannot be met with in the whole world. Perhaps not, yet we are inclined to believe that America can show the beginning, if not the completion, of many such; and we have yet to hear of any failure in consequence of any attempt to make temperance, thrift, and education determining elements in the selection of the members of the industrial community.

Practical experiments of this sort are of inestimable value for the determination of the labor problem, and with it the greater problem of the stable peace and prosperity of all men. It not only pays the workman to be industrious, steady, careful, and thrifty, but it pays the employer to surround himself with such men, and to throw all the influence he exerts upon the side of wholesome, enjoyable, and prosperous living. The workman's personal worth has a money value, and is worth paying for. Were all employers to realize this truth in the selection of their workmen, the relations between employers and employed would be far more satisfactory.

PULSATING LUBRICATOR.

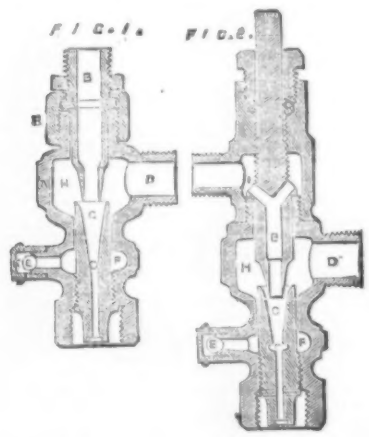
WE subjoin an engraving of a new form of lubricator for steam engine cylinders, designed and patented by Dr. Paulson, of Loughborough, England, and of the performance of which we have received very favorable accounts. The construction of the lubricator is very simple. The apparatus consists of a chamber for receiving the oil or tallow, this chamber communicating by a small passage with the cylinder or valve chest into which the lubricant has to be admitted. In the passage is placed a small ball valve, as



shown, this valve having a lift which is adjusted according to the requirements of the case. At each stroke of the engine there is a greater or less variation of pressure on the underside of the valve, and the latter is thus made to "beat" at each stroke, each time it lifts allowing a small quantity of the lubricant to pass it. Of course the lubricator only acts when the engine is running, and there is thus no waste of lubricant. The arrangement is a very simple and promising one.—*Engineering.*

HALL'S INJECTOR.

THE engravings illustrate two forms of the injector by Mr. Joseph Hall, of Manchester, England. It will be seen from an inspection of the engravings that Mr. Hall dispenses with the ordinary interior regulating spindle, and the ordinary means for regulating the steam nozzle relatively to the opposite or receiving orifice or passage. He immerses the injector in the water of the supply cistern, or places it at or below the level of the same. In the former case the body of the injector is pierced with holes for admitting the water to the interior-chambered-out part of the body of the injector, and in the latter case the injector is connected to the water-



supply cistern by a pipe. The steam nozzle is placed immediately in front of the orifice part, which rises into the chamber, and is made in one piece with the receiver; the tube is pierced with say two or three holes at or near the middle of its length, and at this part the body of the injector is chambered out to form an outlet fitted with an automatic vacuum valve, by preference an India rubber ball. The object of the holes and the valve is to get rid of the air, and enable a vacuum to be created when starting. The steam nozzle is inserted in the hollow body of the injector, and is held in place by a union nut screwed on the outside of the body, and pressing on a collar on the nozzle, with a back nut on the outer screwed end of the nozzle for regulating by screwing the union nut with nozzle and back nut up or down, as required, according to the pressure of the steam in the boiler. The figures are sectional views of two forms of the apparatus.

Referring to Fig. 1, A is the body of the injector, cored out as shown; B is the steam regulating nozzle, connected by socket or union with the steam supply pipe; the nozzle, B, terminates immediately opposite or in the mouth of the tube, C, which takes the place of or combines in one the receiver and the ordinary orifice or coned passage leading to the receiver; this tube rises into the water chamber, H, and is, at or near the middle of its length, pierced with one or more holes, communicating with a chambered out part, F, which is fitted with an automatic vacuum valve, E, say in the form of an India rubber ball; one or more passages are formed in the screwed cap, K, leading to the atmosphere. The steam nozzle, B, is held in its place in the body, A, of the injector by means of the union nut or regulator, R, screwed on the outside of the body, A, and pressing on a collar formed on the outside of the nozzle, B; the back nut is seen on the outer screwed end of the nozzle, B. The regulator nut, R, serves to regulate the nozzle by screwing the nozzle with its two nuts up or down, as required, according to the pressure of steam in the boiler, and that obviously without disconnecting the injector at all. Instead of a lock or back nut the regulating nozzle, B, may be fitted with one or more pegs, or equivalent means for taking hold of it by means of a spanner for regulating the nozzle as required. D is the water-supply opening, connected to the water in the cistern; the injector is chiefly intended for working immersed in the water in the supply cistern itself. The body of the injector may be pierced at the chamber part, H, with holes for admitting the water instead of having a water inlet shank, D.

In Fig. 2 the regulating steam nozzle, B, is formed with a solid stem or regulator at one end; this stem passes out through a stuffing box and gland, and is formed with a square for facility in turning it so as to adjust it according to the pressure of steam in the boiler. The stem is screwed, and the body of the injector forms the nut for it. The nozzle, B, communicates with the chamber, I, by means of one or more openings, and this chamber is connected to the steam supply pipes. The apparatus is in other respects like that described with reference to Fig. 1, only that the receiver tube, C, is chambered out where it is pierced for communication with the chamber F. The action of the injectors described is as follows: Steam being admitted from the steam pipe to the nozzle, B, it will first displace the air and water contained in the apparatus, and expel the air, together with some water, through the vacuum valve, E; on partially condensing by contact with the water from the cistern, which enters into the chamber, H, a partial vacuum will be created in the chamber H and the tube C (which rises into a solid body of water in the chamber H), whereby the water is induced, and commingles with the steam in the ordinary manner, the steam while condensing imparting its speed and impetus to the water. The vacuum valve, E, closes automatically immediately the partial vacuum has been created, and remains closed, as there is always a partial vacuum in the chamber, F, so long as the injector is at work. This form of injector is chiefly intended for being supplied by a head of water from a cistern. Injectors constructed as described are more particularly applicable to locomotives and other moving engines or bodies. When they are applied to stationary boilers the vacuum valve, E, is not required, and water may therefore be drawn in at this place also during the regular working of the apparatus.—*English Mechanic.*

ENGLISH ENGINEERS AND AMERICAN BRIDGES.

A LONDON correspondent of the New York *Times* gives as below the salient facts and opinions lately called out during a week's discussion, by the British Institute of Civil Engineers, of a paper read by Mr. Thomas Curtis Clarke, Civil Engineer, on the "Design Generally of Iron Bridges of Very Large Span for Railway Traffic."

It is fifteen years since the British Institute of Civil Engineers had before them the consideration of the construction of iron railway bridges of long spans as employed in America. At that time the longest span in America was the central tube of the Victoria Bridge, at Montreal, 330 feet in the clear. Since then, trussed girder bridges have been built up to 515 feet clear span, which is the length of the channel span of the Cincinnati Southern Railway bridge over the Ohio. This is the longest railway girder yet constructed. The Kuilenburg bridge in Holland is the next longest, being 492 feet in clear span. The side arches of the steel bridge over the Mississippi at St. Louis are 502 feet in the clear, and the central one is 520 feet in clear span between the masonry. All these American bridges are "pin-connected." This style of construction is preferred by American engineers for spans exceeding 100 feet, on account of the mathematical certainty with which the strains can be calculated, the ease, celerity, and economy of erection, which, for rivers subject to sudden floods, is a matter of vital importance; and lastly, because it is believed that the parts of a bridge can be more strongly united in this way than by riveting. "Add to this," said Mr. Clarke, "a considerable possible reduction in dead weight of iron over that of riveted construction, and the power of being able to calculate the deflection, or camber, beforehand with certainty, and reasons enough have been given why this construction is preferred by American bridge designers." The channel span of the Cincinnati Railway bridge is submitted to the English Institute as an example of a well-designed girder of the type now most approved in America, and the bridge of three spans of 375 feet each, carrying the same railway over the Kentucky River, is also selected as the fellow-subject of note. After an elaborate description of the works connected with the erection of these bridges, Mr. Clarke stated that the cost of the Ohio bridge, including staging, was about £3 10s. per ton, while the other bridge was made for £2 10s., the difference being occasioned by the staging and crib of the first one being carried away by a freshet. Mr. T. H. Linville, member of the American Society of Civil Engineers, who built the bridge, is the author of five other first-class bridges, having channel spans of from 319 feet to 515 feet in length. "This last one," Mr. Clarke observes, "represents the best practice yet attained, and does great credit to its accomplished designer." He then described at length Mr. Shaler Smith's suspension bridge over the Kentucky River, which, he said, "is not only one of the boldest and most original pieces of bridge engineering in America, but when judged by the crucial test of accomplishing a great deal at the least possible cost, it stands very high among engineering structures all over the world." Economy of design is said to be conspicuous in these American bridges. Almost startling illustrations of this success are found in comparing the famous Kuilenburg bridge with the latest American design. The Mayence and the Saltash (England) bridges do not compare unfavorably with the American model. But the work of the Dutch engineers presents a remarkable difference in the amount of metal used to attain nearly similar results. The Kuilenburg bridge has a span of 492 feet; the Ohio, 515. The dead load of the Dutch bridge, together with a live load of 3,000 pounds per lineal foot, strains the iron 14,560 pounds per square inch. Although it carries but one line of rails, the bridge is wide enough for two; while to increase the American bridge to 30 feet would add about 450 tons of iron to its weight. To carry this, and that of a load of 3,000 pounds per lineal foot, would increase the strains on its chord members from 10,000 pounds per square inch to 13,900 per square inch, so that it would then even be stronger than the Kuilenburg bridge. The Dutch bridge contains 2,234 tons of metal: the American, 30 feet wide, would have 1,626 tons, or 600 less than that of this Dutch bridge, 23 feet less span. "It strikes an engineer accustomed to American practice with surprise that the designer of the Kuilenburg bridge, apparently not satisfied with the excessive dead weight of the iron work, has piled upon the structure 656 tons of timber and iron plates. The engineer of the Ohio River bridge was able to confine the weight of the track and guard timber to 60 tons." Mr. Clarke having referred to other examples of American engineering, and put in a wonderful collection of plans, designs, and other drawings, Mr. W. H. Barlow, Vice-President of the Institute, opened the debate in a speech of special interest.

FAMOUS ENGLISH ENGINEERS ON AMERICAN WORK.

Mr. Barlow said, considering the long list of American girders of great span, exceeding 300 feet, erected since 1870, he thought English engineers might look with envy upon their American brethren, in having such numerous opportunities for the exercise of their professional skill. In Mr. Clarke's description of the method in which Mr. Linville had erected the bridge over the Ohio River, and of the manner in which Mr. Shaler Smith had erected the bridge over the Kentucky River, there are examples of fertilities of resource in American engineers which both the elder and younger members of the profession might follow with great advantage. In large spans it is a matter of considerable importance to study the details of the structure. He had looked into the question of pin-connections and rivet-connections. In suspension bridges there is a surplus of metal of about 10 per cent. arising from the use of pinconnections, while in riveted girders the waste amounts to 30 per cent. He questioned, however, whether the pin-connection, being a joint and liable to motion, was, in point of durability, as good as the other. He considered that Brunel's Saltash bridge ranked on a par with the American bridges. Stephenson's tubular bridge suffered by comparison, but it was built 30 years ago. Mr. Benjamin Baker then took up the debate. He said that, for some reason or other, the American type of structure had not yet found favor in England or in Europe. About a fortnight ago a Continental builder offered him some American bridges, and when he mentioned the difficulty of finding a market for them in this country, because of the prejudice against the type, the builder replied that they had been offered all over Europe without success. There seemed, however, Mr. Baker said, no reason in this prejudice, except perhaps that girders of the American class required to be very carefully manufactured, especially in the eye-bars. Since Mr. Colburn introduced this subject fifteen years ago there has been a great assimilation between American and European practice, and in no point more than "the strains." Mr. Shaler Smith, of America, had sent him a specification of a recent bridge, and he observed that in the floor suspenders there was a strain of only two tons to the square inch, whereas in some of the early timber bridges of the Erie Railway the strain on the suspenders was 23 tons, and even after the bolts had failed and been replaced by stronger ones as much as 17 tons was imposed. On the other hand, European engineers had approached the Americans in doing away with stunted box-girders and tubular bridges, and in adopting the open-lattice type of bridge. The difference was now mainly between rivets and pins. Mr. Matheson dwelt at great length upon this point, and his conclusions were favorable to rivets. Mr. Clarke, he said, had compared the weight of American girders with the weight of English girders, to the disadvantage of the latter. "No doubt," he said, "the superior iron obtained in America allowed economy in that direction. There is also a saving by leaving out certain portions, the omission of which would be forbidden in England. Mr. Clarke, for instance, deprecates such a waste of material as is involved in putting a platform on a bridge. That may explain the fact that trains in America often run off the rails and fall through the bridge. Mr. C. Douglas Fox, who followed Mr. Matheson, was of opinion that those members of the institute who had the privilege of visiting America from time to time during the last 20 years would realize the rapid progress which has been made there in iron construction generally, and toward the solution of the important question now brought forward by one of the most prominent American engineers in that particular line of business. In 1857 iron bridges were in their infancy in America; but since that time they have greatly increased in numbers, and they exhibit a marvelous improvement in their details. At the same time as they had increased their knowledge he held that they had drawn nearer the English types of construction. As to the American practice of advertising for proposals, both for designs and construction, that system would take many years to introduce into England, and though it had some advantages, he thought its adoption would not tend to an increase of scientific knowledge or to an improvement in scientific construction. As to pin construction, he was in favor of the American plan, which had been in practice in his own office for nearly 15 years for all spans exceeding 80 feet; below that span he adopted the ordinary rivet construction and plate-girders.

AMERICAN AND INDIAN BRIDGES.

Dr. Siemens, while discussing the merits of steel and iron in the construction of bridges, said that, for engineering purposes, he would restrict the use of very mild steel. In the New York bridge which he saw in progress last year, the steel wire was tested to nearly 100 tons per square inch. In his own practice he generally applied 80 or 90 tons as the weight which steel wire for telegraphic purposes ought to bear. But between the two limits—between the material that would bear a breaking strain of 28 tons and elongate 25 to 30 per cent. before breaking and the highly-wrought material which would bear 80 or 90 tons to the square inch—there are a great many steps, all of which are applicable under circumstances such as practice must indicate. Sir C. A. Hartley later in the debate paid a high compliment to

American engineers. He desired to refer to two bridges as notable types of American iron bridges of large spans, the Louisville bridge having among its 27 spans one span of 400 feet and one of 370 feet, and the St. Charles bridge having four spans of 320 feet and three of 305 feet. In the Louisville bridge the total weight of wrought and cast iron in the 400-foot span was 627 tons, and the total dead weight of the span, including its two overhanging side paths, was 743 tons, or 4,162 pounds per lineal foot. The bridge, in addition to its own weight, was proportioned for a rolling load of 2,600 pounds per lineal foot, and with this maximum load the factor of safety in the cast-iron braces is from five to six by Hodgkinson's formula. The depth of truss of the 400-foot span, which Col. Fink called "a modified triangular truss," was 46 feet, or less than one-ninth of the span; the proportion in the wrought-iron trusses of the Cincinnati and Louisville bridges, specially cited by Mr. Clarke, being one-tenth of the span. Mr. Clarke's paper and the discussion thereon would doubtless be read with special interest by railway engineers in India, where as yet only six bridges have been erected, the spans of which exceed 180 feet. With the exception of the Bahowalpore bridge, the foundations of which are carried down to the depth of 100 feet, no bridge in the Punjaub has greater spans than 142 feet, the precise length reckoning from center to center of the piers of each of the 64 wrought-iron trussed spans of the famous bridge across the river Chenaub at Wuzerabad.

MR. SHALER SMITH ON THE BRIDGES OVER THE OHIO AND KENTUCKY RIVERS.

Mr. C. Shaler Smith stated, through the Secretary of the Institute, that the more signal example of economy was shown in the bridge over the Ohio River. The Steubenville span was proportioned for 4,000 pounds working load per foot. Bearing this in mind, it was not so far behind the other bridges as it appeared to be at the first glance. The longitudinal stability of the Kentucky iron piers was required to be such that a train weighing 1,125 tons, with a brake applied to every wheel, and the wheels all sliding on the rails, should not produce tension at any part of the pier leg or base. The specifications required that the piers should have much larger bases to meet lateral and longitudinal strains than had been given to the piers of the great French and Swiss viaducts, in any of which serious tension would be produced during such storms as are common in America. In the case of the Kentucky River bridge, it was provided that there should be added to the strains produced by the rolling load 30 per cent. for rail joists, 25 per cent. for floor beams, and 20 per cent. for counter-rods. Also a pressure of wind of 31½ pounds per square foot, or twice the surface of the spans and iron piers, plus 315 pounds per lineal foot on the train, extended entirely across the bridge. When exposed to these lateral forces the piers are so proportioned as to be without tension at any part of the base.

The *Minutes of Proceedings*, which will be issued to the members of the Institution of Civil Engineers, referring to the design generally of iron bridges of very large span for railway traffic, will occupy about 80 pages, and will be illustrated by some dozen large lithographed plates. It will be one of the most important works issued during Mr. Bateman's year. Mr. James Forrest, the able Secretary of the Institute, edits it, and the work cannot fail to be accepted as a tribute to American progress, as well as a valuable contribution to the literature of engineering. But few scientific men in the United States are likely to see it; and in England the work does not go outside the circle of the institution. I have therefore availed myself of an early copy (by favor of the society) to make this résumé of the leading facts brought forth in the paper and discussion. The subject is full of interest for scientific engineers and builders; and some of the opinions which crop up in the debate are suggestive, and supply points worthy of consideration in regard to the future bridging of rivers in the railway service of America.

HYDRAULIC DUMPING.

THE idea to use hydraulic pressure in discharging the loads of railroad cars, etc., into the hold of vessels is not new, having been tried ten years ago already at Amsterdam. Entirely new is, however, a device introduced a short time ago on the Hamburg quays, and of which we take a short description from *Der Bergmann*.

As in similar constructions, the car or wagon is rolled on a platform, which, in this instance, rests with one end on the edge of the quay and swings around a horizontal axis, situated at a distance from the quay of about one-third of the entire length of the platform. The other end rests on a piston, moving in a cylinder filled with water, the resistance of which must be overcome during the downward journey of the platform, by which the water is forced from the cylinder into an accumulator. As soon as the car has reached its proper position on the platform, the front wheels act on a system of levers, which raise two clutches engaging the front axle of the car and holding the same in position. The car is then also secured at the rear end. The platform exerts now on the piston a pressure of about 25 atmospheres; by opening a valve communication is opened with an accumulator of a pressure of about 20 atmospheres. The difference in pressure of five atmospheres forces the accumulator upward; this upward motion increases in rapidity as, by the change of position of the center of gravity of the car, the pressure in the cylinder is gradually increased to 40 atmospheres. As soon as the platform has attained an inclination of 45°, the accumulator has risen high enough to touch a lever, by which communication between itself and the cylinder is interrupted. Meanwhile the contents of the car have been dumped over the scoop-shaped end of the platform into the hold of the vessel below and the pressure in the cylinder has been reduced from 40 to 16 atmospheres. Connection with the accumulator having now been restored, the platform is brought into its original position by the overpressure of 20 — 16 = 4 atmospheres. Should the cargo of the car not weigh enough, a little water may be drawn from the accumulator by a separate stopcock. Hereby the pressure is reduced and the platform lowered far enough to produce the necessary pressure by a change of position of the center of gravity of the car. Glycerine may be substituted for water when the apparatus is exposed to very low temperatures.

The principle involved in this apparatus is the storage of the weight of the cargo in an accumulator, and its employment for raising the empty car and platform after discharging the load. In this point the apparatus differs from all others in use, as they all require a separate motor.

ACCORDING to R. Anderson, not one-half of the public buildings, churches, and chapels of Great Britain and Ireland are provided with lightning conductors.

A NEW MEANS TO PREVENT INCRUSTATIONS IN BOILERS.

A BIRMINGHAM firm, Cooper & Smith, recommend for preventing the formation of incrustations in boilers two preparations made by them, and consisting of tannate of sodium. They are put into the market as "crystallized tannate of sodium" and "liquid tannate" respectively. The latter is a solution of tannic acid in one of carbonate of sodium, and contains about 12 per cent. of tannin. The liquid has a specific gravity of 1·105, and is of a dark red color. The latter is probably caused by the oxiding action of the air on the tannin. The crystallized tannate has a similar composition, containing less tannin, however. Both preparations are easily soluble in water, and perfectly free from substances which might rise with the steam and injure the machinery. They do not attack the boiler walls, and many of the owners of large factories have testified to the efficiency of those preparations as preventives of incrustations, and to their tendency to loosen and destroy those when already formed.

AMERICAN ANTHRACITE COAL IN THE MEDITERRANEAN.

THE following is taken from an Austrian journal: "The fact that two cargoes of anthracite have been shipped to a French port not long ago, calls our attention to a new field, in which we shall have to meet American competition. The first samples of that coal brought more than the cost of transportation, while the last lot already was sold at 40 francs, enough to pay all expenses and allow a nice profit to the exporter. The Mediterranean ports import annually 200,000 tons of English coke at the rate of 60 francs per ton, and as anthracite is equally good, we may predict a large export of the same for America. We are, therefore, prepared to meet American coal in very short time at Trieste and all other Mediterranean ports, and our coal trade will be put to a serious task in trying to hold its own against the new rival."

AERIAL ECHOES.*

By PROF. JOSEPH HENRY.

DURING the year 1877, and also in 1876, a series of experiments was made on the aerial echo, in which I was assisted in the first series by General Woodruff, engineer of the third lighthouse district, and in the second series by Edward Woodruff, assistant engineer of the same district. These experiments were made principally at Block Island, but also Little Gull Island. Especial attention has been given to this phenomenon, which consists in a distinct echo from the verge of the horizon in the direction of the prolongation of the axis of the trumpet of the siren, because the study of it has been considered to offer the easiest access to the solution of the question as to the cause of all the abnormal phenomena of sound, and also because it is in itself an object of much scientific interest.

In my previous notice of this phenomenon, in the report of the Lighthouse Board for 1874, I suggested that it might be due to the reflection from the crests of the waves of the ocean; but as the phenomenon has been observed during all conditions of the surface of the water, this explanation is not tenable.

Another hypothesis has been suggested, that it is due to a flocculent condition of the atmosphere, or to an acoustic invisible cloud, of a density in different parts differing from that of the general atmosphere at the time. To test this hypothesis experimentally the large trumpet of the siren was gradually elevated from its usual horizontal position to a vertical one. In conception, this experiment appears very simple, but, on account of the great weight of the trumpet, it required the labor of several men for two days to complete the arrangement necessary to the desired end. The trumpet, in its vertical position, was sounded at intervals for two days, but in no instance was an echo heard from the zenith, but one was in every case produced from the entire horizon. The echo appeared to be somewhat louder from the land portion of the circle of the horizon than from that of the water. On restoring the trumpet to its horizontal position, the echo gradually increased on the side of the water, until the horizontal position was reached, when the echo, as usual, appeared to proceed from an angle of about twenty degrees of the horizon, the middle of which was in the prolongation of the axis of the trumpet. A similar experiment was made with one of the trumpets of the two sirens at Little Gull Island. In this case the trumpet was sounded in a vertical position every day for a week with the same result. On one occasion it happened that a small cloud passed directly over the island on which the lighthouse is erected, and threw down on it a few drops of rain. At the moment of the passage of this cloud the trumpet was sounded, but no echo was produced.

From these experiments it is evident that the phenomenon is in some way connected with the horizon, and that during the continuance of the experiments of sounding the trumpets while directed toward the zenith, no acoustic cloud capable of producing reflection of sound existed in the atmosphere above them.

Another method of investigating this phenomenon occurred to me, which consisted in observing the effects produced on the ears of the observer by approaching the origin of the echo. For this purpose, during the sounding at the usual interval of twenty seconds of the large trumpet at Block Island, observations were made from a steamer, which proceeded from the station into the region of the echo, and in the line of the prolongation of the axis of the trumpet, with the following results:

1. As the steamer advanced, and the distance from the trumpet was increased, the loudness of the echo diminished, contrary to the effect of an echo from a plane surface, since in the latter case the echo would have increased in loudness as the reflecting surface was approached, because the whole distance traveled by the sound-wave to and from the reflector would have been lessened. The effect, however, is in accordance with the supposition that the echo is a multiple sound, the several parts of which proceed from different points at different distances of the space in front of the trumpet, and that as the steamer advances toward the verge of the horizon, it leaves behind it a number of the points from which the louder ones proceed, and thus the effect upon the ear is diminished as the distance from the trumpet is increased.

2. The duration of the echo was manifestly increased, in one instance, from five seconds, as heard at the mouth of the trumpet, to twenty seconds.

This would also indicate that the echo is a multiple reaction of varying intensities from different points, and that at the place of the steamer the fainter ones from a greater distance would be heard, which would be inaudible near the trumpet.

3. The arc of the horizon from which the echo appeared to come was also increased, in some cases, to more than three times that subtended by the echo at the place of the trumpet. This fact again indicates that the echo consists of multiple sounds from various points at or near the surface of the sea, the angle which the aggregate of these points subtend necessarily becoming greater as the steamer advances.

But perhaps the most important facts in regard to the echo are those derived from the series of observations made in regard to it by Mr. Henry W. Clark, the intelligent keeper of the principal lighthouse station on Block Island, and by Joseph Whaley, keeper of the Point Judith lighthouse. Mr. Clark was furnished with a time-maker to observe the duration of the echo, and both were directed to sound the trumpets every Monday morning for half an hour, noting the temperature, the height of the barometer, the state of the weather as to clearness or fog, the direction and intensity of the wind, and the surface of the ocean.

From the observations made at these two points, for more than two years at one station and over a year at the other, the echo may be considered as produced constantly under all conditions of weather, even during dense fogs, since at Block Island it was heard 106 times out of 113, and at Point Judith 50 times out of 57, and on the occasions when it was not heard the wind was blowing a gale, make a noise sufficiently intense to drown the sound of the echo. These results appear to be sufficient to disprove the hypothesis that the phenomenon is produced by an acoustic cloud accidentally situated in the prolongation of the axis of the trumpet. It must be due to something more permanent in its effects than that from a portion of air differing from that of the general atmosphere in temperature or density, since such a condition cannot exist in a dense fog embracing all the region of the locality of the phenomenon. Indeed, it is difficult to conceive how the results can be produced, even in a single instance, from a flocculent portion of the atmosphere in the prolongation of the axis of the trumpet, since a series of patches of clouds of different temperature and densities would tend to absorb or stifle by repeated reflections a sound coming from their interior, rather than to transmit it to the ear of the observer.

The question, therefore, remains to be answered: What is the cause of the aerial echo? As I have stated, it must in some way be connected with the horizon. The only explanation which suggests itself to me at present is, that the spread of the sound which fills the whole atmosphere from the zenith to the horizon with sound waves may continue their curvilinear direction until they strike the surface of the water at such an angle and direction as to be reflected back to the ear of the observer. In this case the echo would be heard from a perfectly flat surface of water, and as different sound rays would reach the water at different distances and from different azimuths, they would produce the prolonged character of the echo and its angular extent along the horizon.

While we do not advance this hypothesis as a final solution of the question, we shall provisionally adopt it as a means of suggesting further experiments in regard to this perplexing question at another season.

* From the Report of the Lighthouse Board, 1877.

THE SILK TRADE OF LYONS, FRANCE.*

IN the course of the past month the stock of silk in our conditioning-house has been somewhat reduced from the month previous. It now amounts to 4,319 bales, or a total weight slightly under 303,331 kilogrammes. Comparing the above stock with that of the corresponding period in 1877, when it was only 3,605 bales, weighing 253,163 kilogrammes, we find an increase of 20 per cent. Although this is the case, there is nevertheless a decrease of 40 per cent. compared with the stock for August. The manufacturers of Lyons are not nearly so well engaged as they were; and the sanguine hopes entertained during August, for September, have not been realized. There are, however, some signs of a revival of the demand, the low prices quoted having attracted the attention of buyers. It is very desirable that in the interests of producers increased operations should take place, as we have not yet arrived at the quiet season of the year. The holders of Italian descriptions of silks, having made some concessions in prices in the early part of the month, are now very firm in resisting a further decline. Chinese silks are held with considerable firmness. Trade, however, is almost everywhere very dull.

Without being disposed to enter into considerations outside the subject, permit me to remark, *en passant*, that the silk trade is in the same predicament as nearly all great industries: we are producing more than is being consumed. We all know that political questions frequently play an important part in the condition of trade; but notwithstanding this admission they are by no means the principal agents that affect it, as is generally believed in France. This country is the classic land—the birthplace of the idea of ascribing to the government the authorship of everything that takes place, be the occurrence good or evil. As I have before stated, we must look to some momentary excesses of production as the most frequent cause of trade depression, and even of the paralysis which sometimes afflict great industries. We should allow the stocks in hand to be sold off, or at least partially absorbed, before manufacturing new supplies.

The United States, thanks to the high protective tariff, have caused the erection of a great increase of silk manufactories, which, without the sheltering influence of the oppressive duties, would not be able to withstand foreign competition; but, on the other hand, the same prohibitive tariff fetters the development of other industries, and as long as the present laws are maintained, will prevent them attaining the prosperity they otherwise would reach. We need not be surprised, therefore, to find springing up, both in the United States and in France, a great cry for commercial liberty. In the latter country this is especially the case at Lyons and St. Etienne.

Our dyers feel the effects of the prevailing dullness; but especially those whose specialty is black work. Dyestuffs are declining in value, and their production is being restricted. This is an important branch of the trade and industry of Lyons.

In fabrics, satin twills and figures are progressing favorably, whilst the *faille* class of goods are declining in public estimation, and have to bear the principal brunt of the depression. Satin goods, in a short time, may possibly play an important part, and one that will not be agreeable to the holders of silk; for in these articles, in consequence of the way in which they are woven, it is easier to replace the silk

* Textile Manufacturer.

shoot by one of cotton than in the taffetas and *failles*. There seems a tendency towards a revival of demand for velvets, which is not coming before it is needed. Owing to the revival of figured goods, printing continues to suffer from depression. The Eastern Question is also partially blamable for this, especially in the handkerchief trade, a great portion of which, particularly madders, found their sale amongst the Turks and the African tribes on the shores of the Mediterranean.

In my August letter I referred to two new blacks. I can now give you some information regarding one of them. It is called the "Eclipse Black." It is not long since this black, discovered by Messieurs A. Giraud and Ruchon, made its appearance in this city; yet already our old firms are compelled to devote a large amount of attention to it. Messieurs Giraud and Ruchon, who have lately commenced business, refrained from beginning with a novelty, in consequence of the fact that for black tram-dyeing there is no demand, whilst for dyeing and filling the demand is general. They have, however, succeeded in producing a very beautiful black, which in the weight for weight dye, produces in the weaving the same effect as if the silk had been charged with only twenty per cent. in the other processes. The important point is to dye the threads without first engaging one's attention with the weight, which can easily be done by the aid of non-swelling metallic charges. Such is the *modus operandi*, and our dyers will do well to devote their attention to it.

From information I have obtained, it appears that the goods made entirely in eclipse black have some very important qualities: they are remarkably soft, with a glove-skin feel, and do not crease or break with rubbing, neither do they become "greasy," the great defect of black silks which have been weighted. The color is a rich black, with a bluish tone, and very fast. It is thoroughly well suited for the silk plush used in hat making.

I defer any remarks about the second dye until my next, my information at present being incomplete. The same remark will apply to the bank stretching machine, of which I promised you a description, as I am awaiting the result of trials at present being made by several manufacturers.

The question of mechanical "tentering" is very prominent in our workshops at the present moment—one of the outcomes of the workmen's strikes. The employers are seeking to reduce hand labor as much as possible, quite as largely from economical motives as to avoid being at the mercy of masses of working men, acting with more or less discretion under the direction of a few leaders.

MONS. MOYRET.

ON THE PRACTICAL VALUE OF WOLFRAM ALLOYS.

CAST steel alloyed with small quantities of wolfram shows a fine, scaly, silky texture, an extraordinary density, fineness, and hardness combined with the tenacity so essential to good cast steel. Cast wolfram steel may be forged and manipulated without any other but the ordinary means, special treatment being only required in hardening and tempering. To tear wolfram steel on the testing machine of the Imperial Polytechnic Institute a greater power was required than for the best huntsman steel, other conditions being equal. This fact shows an extraordinary firmness of wolfram steel. Tests to ascertain the absolute strength of three samples each of huntsman and wolfram steel, at the Imperial Iron Works at Reichraming, gave the following results:

WOLFRAM STEEL.

Area of cross-section of bars.	Weight necessary for tearing.	Absolute strength.
0·060 sq. inch.	3,800 kg.	63,350 kg.
0·058 " "	3,875 "	67,700 "
0·062 " "	4,500 "	72,550 "

HUNTSMAN STEEL.

Area of cross-section of bars.	Weight necessary for tearing.	Absolute strength.
0·055 sq. inch.	2,875 kg.	52,250 kg.
0·062 " "	3,327·5 "	53,600 "
0·065 " "	3,100 "	47,700 "

Wolfram steel requires for hardening a higher degree of heat than English cast steel. Hard chisels, tempered between cherry red and blue, wear most excellently on iron and steel, about 80 blows being necessary in order to produce a noticeable effect on the cutting edge of the chisel. The same excellence was observed in other tools. A mixture of five parts of pulverized yellow rosin, three parts of tar, and two parts of tallow may be used in tempering. Afterward the articles are again introduced into the fire, brought to a light cherry red heat, and cooled off at 12° R.

It must not be overlooked that while the cost of wolfram iron is only slightly in advance of that of ordinary iron, its value is considerably higher. The greater durability and safety of wolfram steel adapt it especially to the manufacture of improved railway material, rails, tires, wheels, axles, couplings, valves, and other parts of machinery for locomotives and cars. The homogeneity and tenacity of wolfram steel, in spite of its cheapness, prevent it from cracking even during the coldest weather, as it is only slightly sensitive to ordinary changes of temperature. Wolfram steel may also be recommended for toothed wheels, and water, gas, and steam pipes.

As far as alloys of wolfram with other metals are concerned, they may easily be produced with gold, silver, copper, lead, tin, zinc, antimony, bismuth, cobaltum, nickel, etc. The resulting products are not merely mechanical mixtures, but genuine alloys, as demonstrated by several analyses. Particular attention is called to an alloy of wolfram, manganese, and copper, also to wolfram-white metal, wolfram-redcast, wolfram-manganese bronze, German wolfram silver (minargent), etc.—*Chemiker Zeitung.*

GALLEIN AND CŒRULEIN.

MR DURAND, who has of late manufactured these dyes on a large scale, says the following about their preparation: One part of phthalic acid and two parts of pyrogallic acid are heated together to 190° or 200°, till the mass hardens; the latter is then extracted by boiling water to remove a small quantity of the acids left undecomposed. Subsequently the mass is dissolved in a solution of carbonate of potassium and precipitated by some acid. The pasty mass thus obtained is gallein; it is sparingly soluble in hot water, coloring it wine red; in cold water it is altogether insoluble. Hot alcohol dissolves it freely, the solution being of a mahogany yellow color. The color of the alkaline solution is of a bluish red or violet, disappearing soon on exposure to the air, becoming brown by the formation of new compounds. Cœrulein is formed when one part of dried gallein is heated with twenty parts of sulphur to 200°; the mass is then allowed to cool, poured into water, and freed of undecomposed matter by continued washing. Cœrulein is neither attacked by acids nor alkalies; thus it possesses the property most essential to a genuine fast dye.—*Chemisches Centralblatt.*

IMPROVEMENT IN THE MANUFACTURE OF CAUSTIC SODA.

BAZIN begins the process by converting the sulphate of soda into sulphide by calcinating it, mixed with charcoal, in a crucible. The mass is then lixiviated with water, and the resulting of sulphide solution boiled with oxide of copper or iron. The copper or iron combines with the sulphur of the sulphide, giving its oxygen to the sodium. The result is thus a strong solution of caustic soda. Although the author believes this process easily applicable to manufacturing on a large scale, as well as more economical than the old process, it may be feared that the double decomposition between the oxide and the sulphide may not so completely take place as necessary to insure a pure product.—*Chemisches Centralblatt.*

A NEW MODE OF PRESERVING WOOD.

MR. LOSTAL, a French railroad engineer, recommends lime as a preservative for wood. He puts the wood to be prepared in large excavations in the ground, and covers them with freshly calcined lime, which is gradually slaked by the addition of water. Wood to be used for mining structures must remain in the lime about eight days before they are fully impregnated. The wood becomes exceedingly hard and never rots. Beechwood prepared in this way has been used as material for hammers and other tools in several factories, and is said to have become as hard as iron, without losing its peculiar elasticity. At Strasbourg lime, slaked in a solution of chloride of calcium, is used as a fire and weather proof pigment for woodwork.—*Schweizer. Gewerbebl.*

COAL GAS AS A FUEL FOR BOILERS.

THE use of coal gas as a fuel for steam boilers is the consequence of the tendency to save money by using the cheapest fuel, *i. e.*, that which will give the largest amount of heat at the least possible cost. The advantages offered by the use of gas are:

1. It is not necessary to introduce as much air to insure complete combustion as it is the case with other material; consequently a smaller quantity of gases is present under the boiler, thereby causing a prompter transmission of heat to the boiler, and, accepting an equal reduction of the temperature of the gases in both cases, less gas will escape unconsumed through the chimney than otherwise.

2. The air has better access to the burning gas than to material in the shape of pieces, especially if the latter forms a thick layer on the grate or consists of small pieces. For this reason every molecule of gas may come in contact with the air and burn completely. The caloric effect of gas is hence greater than when other material is used.

In regard to the first point we will demonstrate the following: 1 kg. of coal theoretically needs 10 kg. of air for complete conversion into carbonic acid and water; in order to obtain the most favorable result we must, however, admit 20 to 21 kg. of air, then we reach a temperature of 1,200° to 1,300° C. If we convert the coal into gas, the theoretically necessary quantity of air remains the same, while the quantity practically admitted may be reduced down to 10·5 to 11 kg. Thus will be reached a temperature of 2,200° to 2,300° C.

If both gases are cooled down to 300° C. with coal 1,600 calories escape into the chimney; in the case of gas only 850. This constitutes a saving of 11 per cent. To this must be added what is saved by complete combustion. How far this saving might be reduced by an increase of capital invested in gas factories and of the running expense of the same cannot be fully ascertained yet, as there is yet a lack of experience.

There is one point which has hitherto been a serious obstacle in the way of the general introduction of gas as fuel, that is, the comparatively rapid destruction of the sheet iron of the boilers. In consequence of the high temperature during combustion the boilers are greatly injured. The heat cannot be transmitted to the water fast enough, and hence the metal walls of the boiler have to serve as storerooms for the same. Especially thick walls burn easily, blister, which with other fuel would not have occurred. Repairs become the order of the day. Some time ago the gas system was introduced in a large German iron works, as the gases escaping from the two large furnaces were perfectly sufficient to supply six boilers with an aggregate heating surface of 360 square meters. As long as coal was used, about two years, no repairs were necessary, but as soon as the gas was introduced the boilers showed blisters all over, even in the first week. There was no alternative but to introduce an excess of cold air. This, of course, rendered the saving an illusion, and only the fact that the gas itself did not cost anything prevented the readoption of coal. From this experiment it may be concluded that the boiler walls should be made as thin as possible and be homogeneous throughout. To that effect they have to be made of steel. Sheet iron, as it has of late years been manufactured, should entirely be discarded where a boiler is to be heated by gas.—L. PAULIN, *in Der Maschinenconstructeur.*

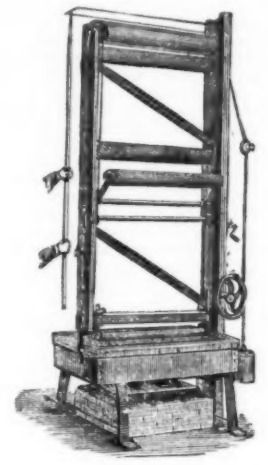
HOW TO MEND PLATINUM VESSELS.

GARSIDE, in the *Chemiker Zeitung*, reports his success in repairing a platinum dish as follows:

A small platinum dish in some way had received an injury in the shape of a small hole near its center. To repair it, I first made a convex plaster cast of the dish, to serve as a sort of anvil. Next I procured a piece of sheet platinum of 3 mm. diameter, and cleaned and polished the same thoroughly, as also the parts of the dish surrounding the opening. The dish being placed on the cast, the hole was covered by the piece, against which the flame of a stationary blowpipe was now directed. A small scissors was used as a hammer. By softly hammering on the small piece I succeeded after some time to combine the same completely with the body of the dish, so that it hardly could be noticed when not carefully examined. The dish could now be used again to all purposes, the mended spot holding out well. The plaster cast cracked in all directions, but retained strength enough for the purpose.

APPARATUS FOR THE PREPARATION OF CARBON PAPER.

THE machine here represented is intended to be used in preparing carbon and transfer paper. It consists of two cylinders, an upper one made of polished wood about 15 c. in diameter, and a lower one of metal much less in diameter. Both of these rest in a wooden frame, which, by means of a screw and nut, can be raised or lowered so as to bring the lower roller to just the surface of a solution of gelatine contained in a zinc trough; the trough itself rests on a water bath. A strip of the paper to be gelatinized is then passed



over the two cylinders, and its ends are fastened together by means of gum or gelatine; a third cylinder resting on moveable iron arms between the other two, serves by its own weight to keep the paper tight. When the upper cylinder is turned by a winch, the paper passes slowly over the warm solution of gelatine. After it is completely coated with gelatine the two ends of the strip of paper are cut through again, and it is hung up to dry on a semi-cylindrical piece of wood that is fastened into the wall.—*Liebert's Photographie en Amerique.*

HOW TO MAKE COPYING PAPER.

THE following is communicated to the *Polytechn. Notizblatt* by E. Dieterich, in regard to the method he employs for making the copying paper which has obtained so good a reputation in Germany. The manufacture may be divided into two parts, viz., the production of the color, and the application of the same to the paper. For blue paper, Dieterich uses exclusively the blue color known as "Paris blue," as covering better than any other mineral color. Ten kgs. of the same are coarsely ground and mixed with 20 kgs. of ordinary olive oil; 0·25 kg. of glycerine is then added. This mixture is for a week exposed in a drying room to a temperature of 40° to 50° C., and then ground as fine as possible in a paint mill. The glycerine softens the hard paint, and tends to make it more easily diffusible.

Then Dieterich melted 0·5 kg. of yellow wax with 7·5 kgs. of ligroine, and added to this 3 kgs. of the blue mixture, mixing slowly at a temperature of 30° or 40° C. The mass is now of the consistence of honey. It is applied to the paper with a coarse brush, and afterward evenly divided and polished with a badger's hair brush. The sheets are then dried on a table heated by steam. This is done in a few minutes, and the paper is then ready for shipment. The quantities mentioned will be sufficient for about 1,000 sheets of 50x90 centimeters, being a day's work for two girls. For black paper aniline black is used in the same proportion. The operation must be carried on in a well ventilated room protected from fire, on account of the combustibility of the material and the narcotic effects of the ligroine. The paper is used by being placed between two sheets of paper, the upper one receiving the original, the lower one the copy.—*Deutsche Gewerbe Zeitung.*

VASELINE IN PHARMACY.

By NATHAN ROSENWASSER, PH.G.

HAVING early last spring been engaged in preparing a few samples of cerates and ointments, with the above mentioned base, for the Paris Exhibition, I made a few different kinds, but rather as types indicative of the wide field which it covers. Vaseline is useful both on account of its inalterability when exposed to any ordinary atmosphere and its property of enveloping alterable bodies so as to render them stable. It is also a good solvent, and its freedom from granular structure renders the introduction of powders not perperfectly impalpable visible, thereby insuring the physician against an oversight to which the pharmaceutist is liable with a granular ointment.

VASELINE SIMPLE CERATE.

Vaseline	16 ounces.
White wax	8 "

Melt with a gentle heat. This cerate keeps well is of medium consistence, and can be used all the year round, not being too hard for cold or too soft for warm weather.

RESIN CERATE.

Vaseline	16 ounces.
Yellow wax	4 "
Resin	10 "

Melt as resin cerate, U. S. P. This offers no advantage over our lard cerate, and requires constant stirring on cooling, as the resin tends to separate readily.

CERATE OF EXTRACT OF CANTHARIDES (without alcohol).

There are two ways of making this.
Process No. 1:

Cantharides (powd.)	5 ounces.
Yellow wax	6 "
Resin	3 "
Vaseline	2 "

Pack the cantharides in a jacketed funnel, and allow the vaseline to percolate through until seven troy ounces of per-

colate have passed; melt the resin and wax, and lastly add the vaseline, stirring until nearly cold. Process No. 2 differs from No. 1 in using coarsely powdered or bruised cantharides, macerating on a hot water bath with eight troy ounces of vaseline for two or three hours, straining with expression, and adding hot vaseline through the strainer till seven troy ounces and one-half are obtained, filtering and adding to the melted resin and wax as in No. 1.

Personal experience convinces the writer that the vesicating properties were dissolved in the vaseline. The product as completed is of a lighter shade than resin cerate. Mr. E. Fougera suggests the use of petroleum benzine in extracting the cantharidin, but I have not tried it as yet.

Pomatum Camphoratum of the French Codex is a very strong solution of camphor in lard and wax. It will, however, turn rancid with keeping. With vaseline it is inalterable, and being a concentrated solution, it makes an excellent substitute for the popular "camphorated oil." The formula is as follows:

Camphor	6 drachms.
White wax	6 "
Vaseline	14 "

Carbolic Acid is not soluble in vaseline in a larger proportion than five per cent., whereas the ointment is directed to be made with 12½ per cent. by the U. S. P. Caution will be found necessary in prescribing too strong a solution with vaseline, as it crystallizes throughout the body of the ointment, and might, if applied upon a large surface, produce a strong local irritation.

Ointment of Iodine.—Iodine is very soluble in vaseline, and I am inclined to believe enters partially into combination with the hydrocarbon, giving rise to a considerable effervescence (probably hydrogen being displaced). Iodine dissolves slowly in vaseline if allowed to macerate in it, or if rubbed up with it, but for ointment of iodine the following gives the best results:

Iodine	20 grains.
Alcohol	sufficient.
Vaseline	1 ounce.

Dissolve the iodine in the alcohol, and mix with the vaseline placed on a hot water bath. Very little iodine will be evaporated during the operation.

Citrine Ointment cannot be prepared with vaseline alone, as the water in the nitrate of mercury solution is repelled by the oil. The vaseline becomes decomposed at 400° F., giving rise to brisk effervescence of nitrous fumes, turning red in color. This color cannot be washed out with water, showing that it is not due to an absorption of the red fumes, but rather to some change produced. A writer in *The Druggists Circular* (August, 1878, p. 141) suggests the addition of one eighth of vaseline in place of the same quantity of lard, adding it after the decomposition has taken place, as rendering the ointment soft and permanent.

Iodide of Iron Ointment.—If iron be added to a solution of iodine in vaseline, and repeatedly shaken (the whole kept liquid on a water bath), the almost black color of the iodine disappears, and if an excess of iron be employed the color becomes green; and if it be then filtered the ointment will have a beautiful emerald green color through transmitted light and almost black by reflected light.

The following is the formula I used:

Iodine	4 drachms.
Iron filings	12 "
Vaseline	16 ounces.

This iodide of iron ointment is stable and almost without taste. I prepared from it a jelly by adding an equal quantity of very fine sugar, in which manner it could be easily taken by children. Mr. E. Fougera, of Brooklyn, has also prepared a bromide and chloride in like manner, and suggests its use in keeping the protosalts of iron by enveloping them in it.

Ointment of Benzoin.—Though benzoin is introduced into lard to keep it, and this is not needed with vaseline, an ointment made as follows (similar to U. S. P.) yields a preparation that preserves the odor of the resin without dissolving the same, and has when finished an elegant quinescent appearance. As an addition to a lard ointment this would be good, probably preventing rancidity without introducing the irritating effect of the resin.

Tincture of benzoin	2 fl. ounces.
Vaseline	16 ounces.

Melt the vaseline on a water bath, add the tincture, stir till all alcohol is dissolved, and pour off the liquid from the precipitated resin which adheres to the sides and bottom of the vessel.

It would be needless to remark that, on account of the difficulty of solubility of resins in vaseline, ointment of mezereon cannot be made readily with it.

Ointment of Iodide of Sulphur.—This ointment was prepared by Mr. E. Fougera, and holds the iodide in solution, and is inalterable, whereas when made with lard it has to be freshly prepared.

Belladonna Ointment.—The blending of aqueous extracts with vaseline is difficult, owing to the water they retain. Taking belladonna ointment as a representative of this type, I placed the extract upon a water bath, and mixed with it an equal weight of glycerine, and conducted the operation until nearly all, if not all, the water in it had evaporated, leaving the extract soft enough to be intimately mixed with the vaseline. This ointment, like almost all when compared with those made with lard, is smooth and uniform.

Those ointments in which powders are mechanically mixed with the body of the ointment would at first thought be found equally as well made with lard as with vaseline. With many probably there would be no difference, except in their tendency to become rancid. The following is a list of those I prepared:

Ointment of tannin.
" " carbonate of lead.
" " iodide of lead.
" " red iodide of mercury.
" " " oxide of mercury.
" " yellow oxide of mercury.
" " oxide of zinc.
" " sulphur.
" " nitrate of silver.

The ointments made with impalpable powders are made more evenly divided in vaseline, on account of the translucent character of this body, which renders every opaque particle visible to the operator, who is thus saved the vexation of having his ointment criticised by the physician as "lumpy," a fault which the unskillful operator is subject to with lard on account of its granular nature and opacity. Of such ointments as oxide of zinc, red iodide of mercury, and yellow oxide of mercury this is especially true.

The *Ointment of Nitrate of Silver* is a new thing in pharmacy. When nitrate of silver is attempted to be mixed with lard or most organic bodies it is decomposed, and the ointment turns black in color. The property of vaseline not being decomposed by nitrate of silver was discovered by a French physician, who desired to use it in ophthalmic practice. He found it inalterable, and wrote to Mr. E. Fougera announcing his discovery. I have succeeded in making an ointment containing one part of the powdered crystallized nitrate of silver to two parts of vaseline. Suppositories of nitrate of silver for urethral and uterine diseases can be made with paraffine and vaseline as a base.—*Druggists Circular.*

SULPHUR AND YELLOW FEVER GERMS.

SOME people have assumed that the yellow fever is caused by vegetable germs generated in the atmosphere. It is very remarkable that no one seems to test the supposition, and decide positively whether it is or not so. When the celebrated horse disease was progressing through the country, such a theory was conjectured in relation to that malady, and then found to be a demonstrable fact. Moistened glass was exposed to the atmosphere before the disease appeared, and after it had arrived, and in all cases, on the glass in the latter case was discovered by powerful microscopes a minute fungus called Aspergillus, and the same was found in the mucous discharge from the nostrils of afflicted horses. There could be little doubt that the Aspergillus initiated the horse disease. It is quite likely that some such minute body is connected with the yellow fever, but why not try whether it is so or not by systematic observations? In a New York paper recently, Mr. Peter Henderson points out that many forms of fungoid matter are destroyed by light doses of the fumes of sulphur that are not particularly injurious to the higher order of animal life; and if this disease is of this nature, relief may be sought for in this direction. It is worth more than a passing thought when Mrs. Ingram, of Nashville, tells us that in many places of every ten fever patients that go under a doctor's hands eight die. In New Orleans one-third die. There is certainly room for discovery.

Since writing the above, we note by the New Orleans papers that sulphur fumes have been most thoroughly tried, as well as other things, with no perceptible result.

One of the most valuable experiences is that of the steamer R. O. Stannard, which went from New Orleans to St. Louis and back. The captain appears to have had an idea that by strict popular precautions he could get through all right. He had the strictest attention given to cleanliness. The vessel was washed with sulphur whitewash, fumigated thoroughly with tar and sulphur, and chloride of lime used freely, and the precautions were continuous and careful. No better chance could offer for testing these precautions than in an isolated vessel like this, but the plague swept through his vessel as elsewhere.

The fact is we do not yet know that the fever poison is certainly fungoid germs, and this matter, as we have already stated, is the first thing to be ascertained.

The whole subject interests horticulturists, of all others in the community, because the locations of our houses and the sanitary surroundings are among the first to be decided by the landscape gardener; and then again the knowledge which horticulturists have to gain of the working of minute forms of plant and animal life may be of good service in tracing out the origin of the plague.

The commissioners appointed by the government to investigate the matter are no more likely to discover the cause than similar commissions have done, and their recent circular shows that they are not likely to do much. The twenty-five questions they have sent out for answers remind us of some sent out by agricultural societies when they wish to find out which of the new fruits are best adapted to general cultivation. The answers will be more conspicuous for what they do not tell than for what they do.—*Gardener's Monthly.*

ON THE NEW METAL GALLIUM.

THE discovery of this new metal differs in its history from that of any other element. All of the latter have been accidentally discovered, and after discovery only we become acquainted with their peculiar, sometimes surprising and unexpected properties. The "blende" found at Pierrefitte, in which gallium was first discovered by Boisbaudran, was, however, already examined by him with a view to find a new element, of the existence of which he was firmly convinced. The existence of an element corresponding in its properties with gallium had been predicted in 1871 already by Mendelejeff and Newlands. These predictions were founded on the chemical equivalents of the elements. It has been found that these form a series of numbers, the amounts and succession of which are governed by certain laws. At the same time it was observed that the properties of the elements entertain peculiar relations to the arrangement of these numbers. The series formed by the latter show irregularities, as if certain members were missing. The position to be filled by one of the missing elements indicated for its occupant properties which would place it between aluminum and iridium. These properties had been to the smallest particular described by Mendelejeff in 1871. He ascertained the specific gravity of the metal yet to be found as 5·9. In operating on small quantities, Boisbaudran found at first 4·7. In 1876, when larger quantities of the metal were obtainable, he found 5·955, exactly as Mendelejeff had predicted.

The application of gallium for filling thermometers for high temperatures is encountered by a peculiar difficulty. The metal in its liquid state has the property to adhere to glass like wax, and before a means is found to prevent this, the utilization of gallium as a thermometrical substance will not be possible.—*Der Bergmann.*

A NEW PROCESS OF MANUFACTURING CHLORIDE OF METHYLEN ON A LARGE SCALE.

LARGE quantities of compounds of methylen are annually used in the production of artificial dyes derived from coal tar. Heretofore the nitrate has been mostly used. As it is, however, comparatively very expensive, and very dangerous on account of its explosiveness, a demand has existed for a long time for a methylen compound less dangerous and expensive. Chloride of methylen was often thought of as answering the purpose, but the lack of a method by which it could be prepared on a large scale prevented its adoption.

Truly it may be easily enough prepared in the laboratory by passing dry hydrochloric acid gas through methylated ammonia vapor, but this process cannot be made use of when large quantities of the chloride are required.

Lately Mr. Vincent, in his researches regarding the products derived from the remnants of beetroot employed for manufacturing sugar, discovered a method by which chloride of methylen may be manufactured on a large scale.

By proper treatment of the remnants and refuse from the sugar manufactory of Tilloy, Delaune & Co., at Courrières, there are produced daily, besides a large quantity of solution of potash, 1,600 kgs. of sulphate of ammonia, 100 kgs. of methylic alcohol, and 1,800 kgs. of a bitter liquid, principally containing salts of trimethylamine, which heretofore had been thrown away as useless.

This liquid is subjected to distillation. At 250° C. a lively generation commences of a gas composed of chloride of methylen and trimethylamine. At 305° the gas carries over a large quantity of ammonia, and at 325° the whole contents distill over as a mixture of watery vapor, ammonia, trimethylamine, and chloride of methylen. By passing the gases through hydrochloric acid, the water and the alkaline constituents are retained by the same, and the pure chloride of methylen may be, after being freed from adhering acid by passing it through an alkaline solution, collected in a meter. It must then be subjected to a pressure of about four atmospheres in order to be reduced to the liquid state.

The manufacture of chloride of methylen is now being carried on according to this process at the above named manufactory and at that of Mr. Birgonnet, of St. Denis. At the latter place the daily production amounts to 800 kgs.

Besides in the manufacture of coal tar dyes, chloride of methylen may be advantageously used to produce cold, by evaporating it as it boils at —23° C. By injecting a current of cold air into the liquid, the temperature may even be lowered to —55°.

NICKEL PLATING ON IRON AND STEEL WITHOUT A BATTERY.

DISSOLVE enough of a salt of nickel in a solution of chloride of tin containing ten per cent. of the chloride till the ordinary color of nickel baths is obtained. The articles, previously well cleaned, are boiled with this solution for from one-half hour to one hour, adding more water to the solution in the measure as it evaporates. The solution must be perfectly free from copper. In the same manner articles of iron and steel may be plated with cobalt.—*Metallarbeiter.*

MAGNESIA AS AN ANTIDOTE FOR ARSENIC.

MAGNESIA has heretofore been considered a reliable antidote in cases of poisoning with arsenic. It has been found, however, that this is only true in case the arsenic is contained in the system yet in the shape of arsenious acid. Should it have been partially converted into sulphuret of arsenic, the formation of a very poisonous sulpho-arseniate of magnesia will be the consequence. Magnesia is, therefore, only of value when administered very soon after the swallowing of the poison.

TEST FOR COLOPHONIUM, RESIN, ETC., IN YELLOW WAX.

FIVE parts of the wax to be tested are heated to the boiling point with four or five parts of nitric acid of 1·33 sp. gr. for about a minute, then an equal volume of cold water and an excess of ammonia are added. The liquid, when decanted from the wax, is of a yellow color, in case the wax was pure, while the presence of resin or colophonium is indicated by an intense reddish brown color. In this way one per cent. of resinous admixture may be easily and distinctly recognized.

NEW MODE OF ANALYZING MILK.

A. ADAM proposes the following new method for analyzing milk, by which butter and sugar may easily be quantitatively determined: The apparatus necessary consists of a pipette of 40 cm. capacity, closed by a stopcock at the upper and by a stopcock at the lower end. Into this are placed 10 c.c. of alcohol of 75°, containing in solution 1-200 of its volume, 10 c.c. of neutralized milk, and 12 c.c. of pure sulphuric ether. The pipette is now closed and well shaken. After a few minutes' repose the liquid separates into two strata, an upper, clear one, containing all the butter, and a lower, opalescing one, containing all the caseine and sugar of milk. The lower stratum is drawn off till only about 1 c.c. remains; the liquid is then again violently shaken, when, after standing, the remainder of the lower stratum is removed. The solution containing the butter is evaporated to dryness in a tared capsule, when the quantity of the residue may be found by weight. It is composed of butter and traces of caseine.

The exact weight of butter may be found by redissolving in ether, which leaves the caseine undissolved, and again evaporating. For determining the quantity of sugar of milk and caseine, the solution containing them is made to measure 100 c.c. by the addition of distilled water, whereupon ten drops of acetic acid are added. The caseine separates as a floccular deposit. After standing a few minutes, it is collected on a filter; the filtrate contains all the salts and the sugar of milk, together with the acetate of sodium formed. The caseine is well washed, dried at 100° C., and weighed. By evaporating a given quantity of the filtrate to dryness, and burning, the quantity of sugar is found in the difference in weight before and after burning, a slight error being caused by the acetate of sodium. By Fehling's solution the quantity of sugar may be more correctly determined. —*Comptes Rendus.*

SOLUBILITY OF PETROLEUM IN LIQUID SOAPS UNDER CERTAIN CIRCUMSTANCES.

A CERTAIN class of soaps is now being frequently encountered in European markets, known by the name of "petroleum soap." Mr. A. Livache, having made a careful examination of the same, reports the following to the *Comptes Rendus:*

The soaps contain petroleum, previously mixed with what is called Carnauba wax. When moderately heated, the petroleum is completely separated, while the soap otherwise remains unchanged. The soaps are perfectly soluble in water, neither the petroleum nor the wax separating. Attempts to mix petroleum with ordinary soap either in a softened state or in solution utterly failed, not even a homogeneous mixture being obtained. The power of rendering soluble petroleum must, therefore, be vested in the Carnauba wax. The latter is an obsolete mixture, forming a soap with

alkalies, and generating melissylic alcohol. The latter has been recognized by the author as the cause of the solubility of petroleum. When this alcohol is separated from the wax, and added to a strong mixture of soap and water, it is entirely dissolved. On the other side, melissylic alcohol is entirely soluble in petroleum in all proportions. A petrolic solution of melissylic alcohol, added to a mixture of the latter and a strong solution of soap in water, combines easily, forming a perfectly clear liquid. Hence the power of Carnauba wax, *i. e.*, melissylic alcohol, as manifested in the petroleum soaps. Further investigations have shown that petroleum may be made soluble in soapy mixtures by other substances dissolving petroleum, and in their turn compatible with those soaps, such as amylic and methylic alcohol.

CONTAMINATION OF SUBNITRATE OF BISMUTH BY LEAD.

IN order to determine small quantities of lead in commercial subnitrate of bismuth, Chapins and Linossier proceed as follows:

Three grammes of basic nitrate of bismuth are treated with (4 c.c.), a 15 per cent. solution of caustic soda, and the same quantity of a 10 per cent. solution of neutral chromate of potassium. The mixture is heated to the boiling point, upon which the supernatant liquid must yet be of a yellow color. After decanting the liquid, the precipitate is again heated with 1 c.c. of the soda solution, a few drops of the solution of the chromate, and about 3 c.c. of distilled water. It is then gathered on a filter. The filtrates and washings being collected, they are slightly acidulated with acetic acid, so as to show a distinct, but not excessive, acid reaction. If lead was present, it is indicated by a yellow turbidness or flocculer precipitate. When the contamination amounts to one per cent, the precipitate is very thick and voluminous; 1 per cent. causes a very pronounced turbidness, and the formation of a precipitate after the lapse of a short time; when only 0·02 per cent. is present, the reaction only takes place when the liquid is quite cool and on standing for some time. Calcium phosphate, silicic acid, and alumina, fraudulently added occasionally, cause the precipitate to be very dense and compact, and may be detected by heating the precipitate in an alkaline solution, when they will be left undissolved, the chromate of lead being perfectly soluble. This test may be executed in a few minutes, excludes errors, and indicates as little as 0·05 per cent. of lead. By using a larger quantity of the suspected nitrate, collecting the precipitate on a tared filter, and weighing, the quantity of lead may be determined by multiplying with 0·6408.—*Comptes Rendus.*

VARNISHES FOR FOUNDRY PATTERNS, MACHINERY, ETC.

THIRTY pounds of shellac, 10 lbs. of Manila gum copal, and 10 lbs. of Zanguebar copal are heated together in a kettle over a steam bath. In five or six hours the mass melts entirely, and must be constantly stirred. 150 lbs. of alcohol are then added, and the whole intimately mixed, while being kept at a heat of 87° C. for another four hours. Then a proper pigment may be added. This is an excellent varnish for patterns, keeping them in shape and not injured by the sand.

For covering machinery, 35 lbs. of shellac, 5 lbs. of Cocoriel copal, and 10 lbs. of Zanguebar copal are by heat dissolved in alcohol. For vessels used in breweries another preparation is recommended, forming also a good first coat of varnish for carriages. Ten lbs. of Zanguebar copal are melted and kept liquid till all impurities have subsided at the bottom. After cooling, the pure and clear portion is separated and powdered. It is then heated with 15 lbs. of red shellac, 15 lbs. of bleached shellac, and 80 lbs. of alcohol, for about four hours under constant stirring. In the meantime 10 lbs. of asphaltum are liquefied in another kettle and mixed with enough turpentine to remain permanently semi-liquid. This is gradually mixed with the contents of the other kettle on the water bath. After 5 lbs. of powdered sandarac have yet been dissolved in the mixture, the whole is allowed to stand for three hours. It is applied with a brush, and subsequently burned in by means of an ordinary soldering lamp.—*Deutsche Industrie Zeitung.*

EXTRACTION OF COPPER AND SILVER.

THE old wet process is based upon the property of chloride of sodium to dissolve sulphuret of silver, *i. e.*, to dissolve it by forming chloride of silver. This has been made use of by bringing the ore, moistened with a solution of chloride of sodium, to a red heat; in doing so the loss of a considerable quantity of silver was incurred through sublimation of chloride of silver. Messrs. A. Drouin, of Paris, and José de Bayeres de Torres, in Valladolid, have found that, if the ore is treated with a solution of chloride of sodium, containing a certain quantity of a mineral acid, the conversion of silver into chloride takes place at ordinary temperature already. The addition of a little hyperoxide of manganese will also aid in promoting the reaction. Copper is dissolved by the same means; from the solution the silver may be precipitated by copper, and the latter by iron. In case the ores contain sulphur, arsenic, or antimony, they have to be roasted with hyperoxide of manganese before treatment with the solution.

MANGANESE AS A REDUCING AGENT IN BRONZES.

ALL bronzes and different kinds of copper as found in the markets contain more or less oxide, which greatly decreases their value, as it makes the metal hard and brittle, instead of malleable and tough. The removal of such oxides has been effected by substances having a greater affinity to oxygen than copper, as, for instance, phosphorus in the manufacture of phosphorus bronzes. Manganese is said to act more energetically, as it does not, like phosphorus, evaporate during the process. For the purpose a combination of copper and manganese has been recommended, called *Cupromangan* by the author, and prepared by him, free of iron, in the following composition: 70·50 copper, 25·00 manganese, 0·50 carbon. An addition of this combination of two and two-thirds per cent. to the bronze will be sufficient. The mode of preparation is very simple. After the bronze has been melted it is covered with a mixture of equal parts of powdered charcoal and carbonate of sodium. Then the composition of manganese, previously broken up in small pieces, is gradually added. They melt immediately, and are incorporated in the bronze. The mass must be kept on the fire, as by the addition of the manganese the temperature is lowered. The carbonate of sodium is added to the charcoal to vitrify the oxide of manganese formed.

BLEACHING OF TEXTILE FIBERS.

THE usual mode of bleaching textile fibers, especially of linen, consists essentially of the solution of the gluten and other impurities contained in the fiber, by boiling the latter for several days with an alkaline lye. Thus the fibers are more exposed and more easily acted upon by the chlorine bath applied afterwards. The chlorine treatment consists in the successive application of chlorine baths, alternated by weak baths of sulphuric acid, muriatic acid, and soda. These are gradually reduced in strength. The acid solutions free the chlorine retained and neutralize the lime, while the soda is intended to saturate the retained traces of acid and thus prevent an injury of the fabric. Repeated washings and exposure to the rays of the sun finish the process.

The disadvantages of the same are the following: The manifold operations with large quantities of water and chemicals which often have to be heated require a considerable capital for buildings and utensils, and involve a great expense for coal and chemicals, highly paid labor, and much loss of time. Besides, the exposure of the article to the sunlight limits the time during which the process can be carried on considerably. In cold weather the chlorine baths are frequently of little if any effect. Mr. C. Beyrich proposes, therefore, to substitute a method, the principal outlines of which he describes as follows:

1. The hypochlorite of lime exhibits a considerably greater bleaching power when used combined with oxalic acid or binoxalate of potassium.

2. Oxalic acid does not attack the fibers as much as the other acids heretofore used.

3. Vegetable gluten and cellular constituents, which have to be removed previous to bleaching by boiling with alkali, do not prevent the bleaching effects of chlorine when oxalic acid or oxalates are present.

The principal moment in the better effect of these two substances when used together is, according to the author, that a part of the oxalic acid combines with the lime of the hypochlorite of lime, thus forming a white precipitate of oxalate of lime and setting free hypochlorous acid. This decomposes spontaneously when in its free state, forming chlorine and oxygen, both of which bleach very powerfully, especially when in the nascent state. Another part of the oxalic acid probably tends to lay open the fibers by its solvent power.

The manipulation must necessarily vary according to the material operated upon, and to some other circumstances, but may be generally carried on as follows:

The fabric is first, without being previously boiled with alkali, treated for five or six hours in a bath consisting of chloride of lime and oxalic acid, at a temperature of from 18° to 26° C. Then the goods are well washed out and, if necessary, treated yet with a weak dilution of sulphuric acid. The latter may in most cases, however, be omitted.

It is advisable not to add the whole quantity of oxalic acid at once to the chloride solution, but only about two thirds, and then quickly to introduce the goods, as just when first generated the chlorine and oxygen exert their utmost bleaching power. The weak sulphuric acid bath to some degree tends to liberate the hypochlorous acid and convert the lime taken up by the fibers into sulphate of lime, which does not injure the appearance and color of the fabric. Finally, the latter is washed with a weak alkaline solution, followed by pure water.

These operations must, as necessity requires it, be repeated with weaker solutions, till the desired degree of brilliancy and purity is obtained. If convenient, the goods may be exposed to the sun for a few days, but only after the alkaline baths, as otherwise just the contrary of the desired effect would be obtained. All vegetable textile fibers may be treated thus, such of animal origin requiring boiling with alkali in order to be freed from fat. The application of the oxalic acid bath to them shortens the process of bleaching materially, however, and insures uniform good results.

For fibers of animal origin Kállab recommends hyposulphurous acid, H_2SO_2, and indigo. The fabric to be bleached is soaked in water in which about 1 grm. of indigo has been mixed to every 100 liters, then well wrung out and then brought into the bath. This consists of a solution of hyposulphite of sodium, of the sp. gr. 1,0283, freshly prepared. To this is added for each liter from 5 to 20 c. c. chemical pure acetic acid of 50 per cent. strength and perfectly free of all mineral acids. Hereby the adhering indigo is reduced to white indigo and taken up by the fiber, while the sulphurous acid separated produces the bleaching at the same time. The indigo is converted into blue indigo again on exposure to the air, and produces that particular snowy white which is produced by the addition of a little blue to all white substances.

THE UTILIZATION OF HOUSEHOLD SEWAGE.

THE question of the utilization and final disposition of human excrements is one of vital importance, inasmuch as the available area of soil is progressively more levied upon to contribute to the maintenance of the human race. The great masses of nitrogenous matter and incombustible constituents of animal and vegetable food consumed in the large cities, which are a direct tax on the soil of the supplying country districts, are to a great extent being carried away to the sea, and efforts to restitute to the soil what has been taken from it, scarce as they have been, have so far been limited to the use of imported fertilizers, as guano, or products of chemistry. Inhabitants of country districts deplore the loss thereby inflicted on the soil they till, while the city population naturally inclines to measures insuring a prompt removal of the excrements, without damage to public health and convenience in general.

To serve this purpose, various means have been made use of. The most universally adopted system is that of canalization, by which the obnoxious matter is washed away by water; it is open to the objection that the water of rivers, etc., is thereby polluted, and the air made unfit for inhalation. The system which is likely to be adopted on a larger scale in all large cities, as it has been in Berlin, Brussels, Paris, etc., is that of removal through pneumatic tubes. The matter to be removed is collected in air-tight vessels, to be emptied into the tubes, or is directly delivered into the tubes, through which it may, by means of pneumatic pressure, be collected at central stations for further disposal. It may, for instance, be diluted with water, so as to be used in watering dry and, to some extent, sterile tracts of land, or it may be turned into artificial manure, as poudrette, etc.

Hitherto it has been thought that by constructions of this character, involving an expense of millions of dollars, the highest attainable means of protecting human life had been secured. Henceforth, our astonishment must be great when we hear that a voice tells us that we have been laboring under a great delusion, that we have been acting according to false principles, and that the money has been expended uselessly. It is the voice of so distinguished an authority as Prof. C. von Naegeli, of Munich, that proclaims such views, founded upon the results of scientific research and competent judgment, in his new work "The Lower Organisms in their Relations to Infectious Diseases and the Preservation of Public Health." The following is an excerpt of the section treating our subject:

"The smallest of all organisms, the minute forms of which are hardly recognized by our most powerful microscopes, the Schizomecetæ, germ cells, which cause the rot of organic bodies, the formation of lactic acid in milk (turning sour), the deposition of slimy matter in wine, the formation of butyric acid in butter, acetic acid in alcohol, carbonic acid and ammonia in excrements, cause the reactions on organic bodies, which, in common, are called 'fermentation.' The microscopic schizomeceton consists of a single cell of globular form, several of which are sometimes united to form a string. They are recognizable under the microscope by their free movements and their reproductivity."

According to Prof. Naegeli's opinion, the schizomecetæ, so far divided into many different species, are traceable to a very few types, each of which appear successively in different forms; different species might, however, produce similar effects in analogic forms. It may be concluded, that by being constrained to a certain nourishment for several generations, they may lose their property of causing fermentation, they may receive an accommodative character, prefer a morphological formation, and become more or less fit, physiologically, to induce a certain mode of decomposition.

The same organism might for once live in milk and cause the formation of lactic acid, then act on flesh and produce rottenness, generate gum in wine, and finally take part in engendering disease in the human body. According to the morphological difference, we speak of micrococci, of vibrionæ, of bacteria, of spirillæ; but it must be observed that these designations are not always applied to the same formations, and that the outlines of the several groups are not at all sharply traced.

The infecting matter does not consist of gases, but of organic bodies, entering the human body by the air. They then exert their noxious influence by destruction and appropriation of the best nourishing material, depriving the blood corpuscles of oxygen, destroying by fermentation the sugar and easily decomposed substances, and separating such products of fermentation as will gradually transform the solid and less soluble parts into soluble compounds.

Prof. Naegeli, after dwelling on the difference between "contagious" and "miasmatic" diseases, and the nature of their transmission, claims that there is miasm or contagion in a gaseous state. The organisms causing disease cannot "evaporate," but will be, in a dry state, taken up by currents of air and transferred to other bodies. The principal entrance is through the lungs and respiration through the capillary vessels of the areolæ, but wounds are also a frequent means of transmission. Drinking water, according to Naegeli, is not at all so frequent a source of disease as generally is believed, as it does not favor the development of the cells. The quantity of the latter contained in the water is comparatively small; the other solid, gaseous and liquid impurities, as a general thing, not of much account. There are examples of tracts of land, in which the habitants are solely relying on impure water, but where no miasmatic or contagious disease has ever appeared. Air contaminated by gases of disagreeable odors offends our sense of smelling, but the presence of germ cells cannot be detected by the smell; on the contrary, they only seem to appear when the air is odorless. Air is dangerous when it has been in contact with places where germ cells have been developed, provided they are in such a condition that they can be carried along by the air. This is not possible while the cells are moist.

The soil is the principal seat of the development of those organisms causing cholera, typhoid and yellow fevers. The germs are generated in wet or flooded soil. In a porous and quickly drying soil, this seat is located in the stratum situated above the water accumulated at a certain depth below the surface, and kept moist by capillary attraction. Should the soil contain a large quantity of organic matter, cells are formed in large quantity, but of that less dangerous type causing the rotting away of organic matter. Miasmatic cells germinate in soil free from rot; they feed principally on ammonia and substances of the humus.

The cells formed in the soil can be removed by the air only when dry, *i. e.*, when the soil dries out. They fly away as particles of dust. Pure soil will more easily allow the removal, as half-decomposed organic substances increase the adhesion between the different parts of the soil.

Healthy the soil may be called when it is always moist, or always dry; in the latter case, the surface of the ground must be well filtered. Unhealthy is the ground that is at intervals wet or flooded, thus allowing the cells to form, while it afterwards dries out to such a degree that the cells may be carried away as dust. The worst districts are those where the ground is flooded from time to time, and dries out completely afterwards, as in the case of rice plantations.

It is generally believed at present that the most obnoxious system of doing away with human excrements is to allow the same to be collected in cisterns, the bottom of which is not coated with cement, stone, or any material, so as to allow the contents to sink gradually into the ground. This pollution of the soil is regarded as especially dangerous. Naegeli claims the contrary, as the same soil is always kept moist, so that no germs can escape from the cistern. When used near houses located on unhealthy ground, the cisterns are even useful, as they keep the foundations of houses moist, and thereby tend to prevent the entrance of cells into the interior. Rain water, however, should be carried away separately, as by allowing it to go into the cistern, a larger area of ground will be moistened than can be kept so by the ordinary contents of the cistern.

Canals, whether closed or open, are not dangerous. The gaseous products of decomposition may be disagreeable, but they are not infectious. Cells which might be generated cannot escape into the air, and, consequently, do no harm. Public opinion labors under the mistake that badly-smelling air is identical with air containing germs of disease. Equally wrong is the idea to believe air purified when the bad smell has been covered by some other smell, or has destroyed it by the application of so-called disinfectants. Chlorine, sulphurous acid, carbolic acid, etc., have, to all appearances, no effect at all on such germs. As long as those canals are in use, they are not dangerous; they become, however, so when allowed to dry out.

The conducting of excrements into rivers may only then be considered dangerous when they contain a limited amount of water only, and are flowing at a very low velocity. Where canals are used to convey excrements to tracts of land under culture, great anxiety has been expressed regarding the health of the population inhabiting such districts. As the

germs generated from excrements belong principally to that class causing rot, while river water promotes the formation of miasmatic cells, the former are undoubtedly safer.

The system most generally adopted is that of removing the excrements in closed vessels, while liquid refuse from kitchens, workshops, etc., together with waste water, are removed by an underground tube system. This proves that the offal of the kitchen is regarded as innocent, and only the excrements are considered dangerous. This is entirely wrong, according to Naegeli, who has observed that germ cells of the most dangerous type are formed in kitchen refuse very rapidly.

In comparing these systems, Naegeli comes to the conclusion that cisterns allowing excrements to sink into the ground are decidedly preferable, reducing the danger through pollution of the soil to a minimum, no matter how extensive the pollution may be. As next best he considers the canal system, where cisterns cannot be constructed. The third system, removal in closed vessels, he denounces as the most dangerous of all.

The cistern system is the cheapest of all, and would only there be discarded where the consumption of the excrements would cover the introduction of a more expensive system. In order to attain this end, chemistry, however, must yet solve a number of problems.

Comparing the condition of things in cities with that of country districts, we observe some peculiar facts. The inhabitant of the crowded city goes to the country to escape the effects of dangerous influences; in the country he sometimes resides in a locality in the immediate neighborhood of a heap of stable manure, of a privy with an open cistern, while liquids consisting of urine and semifluid excrements are covering patches of yard and street, and manure is being spread on adjoining fields; the air is contaminated with gaseous products of decomposition, which in the city are feared to the extreme, and, nevertheless, the population of that country town does not know diseases like cholera and typhoid fever. Is this not strange? Prof. Naegeli tries to explain the mystery. It is because the soil is largely polluted and kept moist by continuous pollutions, that the ground is not dangerous. The large amount of colloid matter acts, even in case of drying out of part of the soil, as an adhesive, fastening the germ cells to the ground, so that they cannot escape to do harm. Naegeli does not doubt that by introducing so-called modern improvements into such rural districts, a new field would be opened to the ravages of contagious diseases. There might be objections raised to the pollution of cultivated soil, but they are practically of no account. The humus in the ground attracts and retains water with avidity, so as to keep moist. It also condenses oxygen from the air, which oxidizes and kills the germ cells as fast as germinated.

The researches of Naegeli are of great importance, as they touch the vital interests of humanity. Not alone the physician, the farmer, but every thinking mind ought to make itself acquainted with the views of the renowned savant on these topics. There may be doubts entertained as to the correctness of some of the conclusions drawn from his observations, but the latter will thereby not lose anything as regards their relation to the progress of hygienic science.—Prof. T. THANSING, *in Wiener Landwirthsch. Zeitung.*

OUTLINES OF CHEMISTRY.*

By HENRY M. McINTIRE, M. E.

IRON.

Iron (atomic weight, 56: symbol, Fe). Iron is the most important of all metals to the human race. It would hardly be too strong an expression to say that upon it rests modern civilization. It is of all metals the most widely distributed in nature, neither is it restricted to the inorganic kingdom. In but very few cases has it been found in the metallic state, but as bisulphide (iron pyrites) and in an oxidized state it is found everywhere and all over. As it is rather difficult to reduce from its ores, it was long unknown to man; still, it has been in general use for no mean period of time. *Pure* iron is of a white color and brilliant lustre. It does not oxidize in dry air, except when heated to redness, while at a high white heat it burns brilliantly, that is if it be in mass, but in a finely divided powder, it will take fire spontaneously and burn in dry air, so rapid is the oxidation. Iron, however, is *never* used in the pure state in the arts. There are always present, besides other things, carbon and silicon. On the amount of carbon present, more particularly, depends the kind of iron. Thus there are distinguished three classes of iron: I. Wrought iron; II. Steel; and III. Cast iron. The first of these is the nearest to purity; the second contains more carbon than the first, while the third contains the greatest amount. The different characteristics of these three classes are too well known to need description. There are four oxides of iron, thus FeO, Fe_2O_3, Fe_3O_4, Fe_2O_6.

Ferrous oxide, or protoxide of iron, FeO, has not been prepared in a pure state, owing to the fact that it rapidly absorbs oxygen and forms a higher oxide; its hydrate may easily be prepared though. This oxide forms with acids the ferrous salts, of which ferrous sulphate, green vitriol ($FeSO_4$), may be mentioned as one of the most important. The oxide colors glass green; witness common green bottle glass, which has iron to thank for its verdant complexion.

Ferric oxide, or *sesquioxide of iron*, Fe_2O_3, occurs in nature in many minerals, and is also easily prepared artificially; with acids it forms the ferric salts. To mark clearly the difference between the *ous* and the *ic* salts, an example will be given: Take ferrous oxide and sulphuric acid, forming ferrous sulphate, $FeO+H_2SO_4=FeSO_4+H_2O$; now take ferric oxide and sulphuric acid, forming ferric sulphate, $Fe_2O_3+3H_2SO_4=Fe_2(SO_4)_3+3H_2O$.

Proto-sesquioxide of iron, or *magnetic*, or *black oxide of iron*, Fe_3O_4, occurs quite frequently in nature (the loadstone is a good example). It is highly magnetic, to which fact it owes one of its names. It does not form a series of salts with acids.

Ferric acid, H_2FeO_4 ($Fe_2O_3+2H_2O$), is known only by its salts, which are very unstable. The acid and oxide have never been separated.

CHROMIUM.

Chromium (atomic weight, 52.5; symbol, Cr). Chromium is not very widely distributed in nature, and is not obtained at all easily in a metallic state. It is supposed to be the most infusible metal known. It is, however, a quite important element, not so much in its metallic state, although there is a steel called chrome steel, which utilizes it, but on account of its salts. Chromium has four oxides, namely, CrO, Cr_2O_3, Cr_3O_4, and CrO_3.

* *Philadelphia Photographer.*

Protoxide of chromium, or *chromous oxide*, CrO. Like the corresponding oxide of iron, this has never been obtained in a free state. It forms a series of salts with acids.

Sesquioxide of chromium, or *chromic oxide*, Cr_2O_3, can easily be prepared and is quite stable. It imparts a fine green color to glass, and is sometimes used in enamel painting. It forms a series of salts with acids. Trichromic tetroxide produces no salts; it corresponds to the magnetic oxide of iron.

Chromic trioxide, CrO_3, crystallized in beautiful, long, ruby-red crystals; it is very deliquescent, uniting very readily with water, to form chromic acid, H_2CrO_4, ($CrO_3+H_2O=H_2CrO_4$), which forms a series of salts called chromates, either red or yellow. All chromates are noted for their brilliant color, and more than one of them are employed as pigments.

MANGANESE.

Manganese (atomic weight, 55; symbol Mn). Manganese was discovered by Gahn, in 1774. It occurs quite frequently in nature, and is not reduced very easily to its metallic state. It is then, that is in its metallic state, of a reddish-white color, very brittle and quite hard, sufficiently so to scratch glass. It decomposes water at ordinary temperatures, and is slowly oxidized by contact with the air, so that it must be kept in a closed tube or under naphtha. It is of no use in the metallic state. Its alloy with iron is used in the manufacture of steel, otherwise it is of more importance to chemists than to any one else. There are several oxides; thus, MnO, Mn_2O_3, Mn_3O_4, MnO_2, MnO_3, Mn_2O_7.

Protoxide of manganese, or *manganous oxide*, MnO, is of an olive-green color, and is not very stable; with acids it forms the manganous salts.

Sesquioxide of manganese, or *manganic oxide*, Mn_2O_3, occurs in nature and may easily be prepared artificially; with acids it forms the manganic salts.

Binoxide, deutoxide, or *peroxide of manganese*, MnO_2. The black oxide of manganese, used for making oxygen and in the manufacture of chlorine. It is also quite a valuable oxidizing agent. It does not produce a series of salts with acids.

Mangano-manganic oxide or *red oxide of manganese*, Mn_3O_4, corresponds to the magnetic oxide of iron. It forms no definite salts with acids.

The remaining two oxides, manganic anhydride, MnO_3, and permanganic anhydride, Mn_2O_7, have not been separated, but are known only in connection with their acids, manganic acid, H_2MnO_4, which forms manganates, and permanganic acid, $HMnO_4$, which forms permanganates.

TIN.

Tin (atomic weight, 118; symbol, Sn). Tin is one of the earliest metals known to man. It is a white metal with a brilliant luster. It is quite soft, malleable, and ductile, but devoid of tenacity. When a bar of it is bent it produces a peculiar creaking sound. Tin is not affected to any extent by air, either moist or dry, but if heated strongly in the air it burns, forming a white oxide of tin. Owing to its permanence, it is often made use of to protect iron plate, covering the iron with a coating of the tin, forming "tin plate." Tin is quite important in forming alloys. There are britannia metal (tin, brass, antimony, and bismuth), pewter (tin and lead), queen's metal (tin, antimony, bismuth, and lead), plumber's solder (tin and lead), speculum metal for making metallic mirrors (tin and copper), bell metal (tin and copper), gun metal (tin and copper), bronze (tin, copper, and zinc), and others of less importance. There are two oxides of tin that will be mentioned, SnO and SnO_2.

Protoxide of tin or *stannous oxide*, SnO, may be prepared, but it is unstable, rapidly absorbing oxygen and forming stannic oxide; with acids it forms stannous salts.

Binoxide of tin or *stannic oxide*, SnO_2, occurs in nature and may be prepared artificially. It may exist in a hydrated state in two different forms, called metastannic acid, $H_2Sn_5O_{11}.4H_2O$, forming metastannates, and stannic acid, H_2SnO_3, forming stannates.

TITANIUM (atomic weight, 50; symbol, Ti). Titanium was discovered by Gregor, in 1791. It is quite rare, and neither in its metallic state nor as a salt is it used in the arts.

NIOBIUM, or columbium (atomic weight, 97.5; symbol, Nb).

TANTALUM (atomic weight, 137.5; symbol, Ta). Niobium, or columbium, was discovered in 1801, by Hatchett, in a mineral called columbite. In 1802 Ekberg discovered tantalum in the mineral tantalite. These two metals were thought to be identical for some time. They have not been investigated into very much, and are but little known.

MOLYBDENUM (atomic weight, 96; symbol, Mo). Molybdenum is so called from the Greek, meaning "a mass of lead," because one of its ores looks very much like plumbago. It is not of frequent occurrence, and although quite useful in analytical chemistry, it is not used in the arts, and would hardly repay a description of it here.

TUNGSTEN (atomic weight, 184; symbol, W). Tungsten is found in considerable quantities in some iron minerals. When in the metallic state it is a white, hard, and brittle metal; sometimes employed in small quantities in the manufacture of steel. When heated to redness in the air it takes fire.

There are two oxides of tungsten: *tungstic dioxide*, WO_2, and *tungstic trioxide*, WO_3. The trioxide is the anhydride of tungstic acid, (H_2WO_4) which forms a variety of complicated salts, called tungstates. Sodium tungstate is often employed in the arts to render fabrics uninflammable.

VANADIUM (atomic weight, 137; symbol, V). Vanadium was discovered by Sefström, in 1830. Very little is known about it. It is more of a curiosity than anything else.

ARSENIC.

Arsenic (atomic weight, 75; symbol, As). Arsenic has been known to the human race for a very long time. It is one of the elements that is often classed with the non-metals. When in the metallic state it is of a dark steel-gray color and brilliant luster. It is quite brittle, sufficiently so to be powdered with ease in a mortar. When heated to dull redness it volatilizes without undergoing fusion, the vapor possessing a characteristic and very unpleasant garlic-like smell. When exposed to dry air the metal is not affected, but if the air be damp the arsenic is slowly oxidized. When heated in the air, it takes fire and burns with a delicate blue flame. There are two oxides of arsenic, As_2O_3 and As_2O_5.

Arsenic trioxide, arsenious oxide, or *arsenious anhydride*, As_2O_3. This is the substance commonly known as arsenious acid, or white arsenic, and is one of the most useful institutions for those that wish to commit suicide that is known. It is slightly soluble in water, forming then the *true* arsenious acid, H_3AsO_3, which forms the salts called arsenates.

Arsenic pentoxide, arsenic oxide, or *arsenic anhydride*, As_2O_5. This is the anhydride of arsenic acid, H_4AsO_4, an acid which forms salts called arsenates, and which resembles the tribasic phosphoric acid very much. Thus, like we had trihydric phosphate, H_3PO_4, dihydric sodium phosphate, H_2NaPO_4, hydric disodium phosphates, HNa_2PO_4, and trisodium phosphate, Na_3PO_4, we have, in like manner, trihydric arsenate, H_3AsO_4, dihydric sodium arsenate, H_2NaAsO_4, hydric disodium arsenate, HNa_2AsO_4, and trisodium arsenate, Na_3AsO_4.

Arsenic unites with hydrogen to form arseniureted hydrogen, AsH_3, a colorless gas, possessing the characteristic arsenic odor and acting as a very deadly poison.

Besides these, arsenic acts as a metal, uniting with chlorine, bromine, etc., to form chloride of arsenic, bromide of arsenic, etc.

ANTIMONY (atomic weight, 122; symbol, Sb). Antimony has been long known to man. It occurs sometimes in nature in the metallic state, but generally in ores from which it is easily reduced. It is, when in the metallic state, of a bright bluish color; quite brittle, crystallizing in the same shape as arsenic. At ordinary temperature it is not affected by the action of the air, but oxidizes rapidly when exposed to the air when melted, and if heated more strongly it burns with a white flame. The most important use for antimony, probably, is in the production of alloys; it seemingly having a tendency to produce a hard and brittle alloy. It is used in type metal, britannia metal, in conjunction with lead, tin, bismuth, zinc, copper, and what not. Like arsenic, it has two oxides, Sb_2O_3 and Sb_2O_5.

Antimonious oxide, Sb_2O_3, unites with acids to form a quite important series of salts, useful particularly in medicine.

Antimonic oxide, or *antimonic anhydride*, Sb_2O_5, is the anhydride of antimonic acid, $H_2Sb_2O_6$, forming with bases antimoniates. Like arsenic, antimony unites with hydrogen, forming antimoniureted hydrogen, SbH_3; also, with chlorine, bromine, etc., as chloride, bromide, etc.

BISMUTH (atomic weight, 210; symbol, Bi). Bismuth, although not a rare metal, is not remarkably abundant. It is hard and brittle, of a pinkish-white color. It is not a very useful metal. It is used in an alloy, having a low melting point, and which, on account of its expanding when cooling, is useful in taking casts of medals and the like. Some of the salts of bismuth are used in a medical way, some as pigments. There are two oxides, Bi_2O_3 and Bi_2O_5. Bismuthous oxide, Bi_2O_3, a yellow powder, formed when the metal is heated in the air; bismuthic oxide, Bi_2O_5, is an anhydride of an acid which forms bismuthates.

ANTHRACNOSE—A NEW VINE DISEASE.

THE current number of *Grevillea* contains an article by Dr. Max Cornu describing a new disease which has attacked the vineyards of the Narbonne district this year. This disease, which has been called Anthracnose, is caused by a fungus known as *Phoma uvicola*, and is characterized by its peculiar effects on the boughs and leaves and grapes. The parasite produces on the grapes a circular spot—black, as if burnt—in the middle of which a smaller white circle is seen, formed by the development of the conidiiferous form of the fungus. On the stem these black spots become a depressed circle; the stem appears corroded and burnt through to the woody tissue, sometimes to the pith. It is this peculiar effect which has caused the malady to be sometimes designated by the name of "canker." On the leaves spots of different sizes are seen, more or less confluent, formed by the dried up tissue which has been affected by the influence of the parasite.

The vines of the district of Etampes have likewise been seriously affected by a fungus this year, although of a different nature—a species of black mould (*Cladosporium*), allied to the mould which produces the black, speckled appearance of pears and pear leaves and causes their destruction. Dr. Cornu attributes the presence of both diseases to the unusual rainfall this year, and believes these species of fungi may prove very formidable in wet seasons.

THE PROGRESS OF SHEEP HUSBANDRY IN THE UNITED STATES.

From an address delivered by Dr. John L. Hayes, before the National Agricultural Congress at New Haven, on the subject of the "Resources of the United States for Sheep Husbandry and Wool Manufacture," we obtain the following interesting facts in regard to this important national industry: "To fully comprehend the blessings we enjoy in our present opulence in sheep and wool," he remarks, "we must consider our resources at the commencement of the Centennial epoch. It is difficult to conceive the poverty in woolens of the masses of the American people a hundred years ago." Wool, in Philadelphia, at the commencement of the war of the revolution, cost seven shillings a pound, and there was not enough in the country to furnish each inhabitant with a single pair of stockings. In our *last* war we clothed, mainly from our own flock, 2,655,576 soldiers as no army was ever clothed before; and at the close of the war, had a surplus of overcoats alone nearly enough to furnish one of these garments to one-third of all the voters in the United States. It is said that in 1800, when linsey woolsey first began to be manufactured in Rhode Island, girls on the Providence plantations were commonly nearly as naked as savages, and invariably hid themselves at the approach of a traveler; now, a single mill in New England, making women's dress stuffs exclusively, consumes for the purpose, every week, the fleece of 10,000 sheep. The number of sheep in the United States, on the first day of January, 1878, as estimated by the eminent statistician of the Department of Agriculture, Mr. J. R. Dodge, was 35,740,500. The prominent facts shown by the table in which Mr. Dodge has given these statistics, are the extension of sheep husbandry in the new Territories: California, 6,561,000, ranking first; Texas, 3,674,700, third; Oregon, Colorado, and the Territories have over four million. This increase in Texas and the new States of the West is partially due to a transfer of sheep from the old to the new States. Ohio, which is credited with 3,783,000 sheep, had, in 1868, 7,622,495. In some of the New England States sheep husbandry has greatly declined, largely through a change to dairy farming for supplying milk to the cities, Massachusetts, Connecticut and Rhode Island, together, having only 177,000. The progress in sheep husbandry is not shown merely in the increase in the number, but by the increase of the wool production; for careful culture, and the introduction of different races, have increased the quality of wool in a greater ratio than is shown by the increased number of sheep. Our wool product in 1836 is estimated at 41,917,324 pounds. The census returns for 1860 place the production in that year at 59,673,952 pounds. In 1866 the clip of the old States had reached 120,000,000 pounds; and that of the Pacific States and Territories 17,000,000 pounds—a total of 137,000,000 pounds. In 1877, there was a production in the old States of 117,000,000 pounds; and in the Pacific States and Territories of 208,000,000 pounds. Thus,

with less than half the number of sheep in the old States, the wool production in the whole country is five times as great as in 1836.

KILLING AMERICAN BEEF FOR ENGLISH MARKETS.

UNDER this heading a correspondent of the London *Field* describes the process of killing cattle at the abattoir near the terminus of the Erie Railway, in Jersey City, across the river from New York. It is at this abattoir that most of the beef is killed for shipment to England. Attached to a large, two-story, square building are immense cattle and sheep pens, flanked on the northern and southern sides by the branch tracks of the Erie and Pennsylvania railroads, which bring live stock right to the pens. At these landings sales take place, and the cattle are driven from these inclosures into pens inside the abattoir. The cattle, coming from so widely varying districts of the vast West, of course differ greatly in appearance and quality; the very best are kept for home (city) markets; an inferior grade, but by no means the poorest, are slaughtered to be sent abroad.

The building is owned by a stock company, and is a model of its kind. The entire floor is concrete, covered at the places where the cattle are slaughtered with heavy pine flooring. Overhead, in rows, from the eastern to the western end of the building, are large hoisting wheels. These are let out by the Abattoir Company in sets of three wheels. There are always three cattle in process of transition to beef, and three men constitute a working gang, some firms keeping several gangs constantly employed. The whole building has about 150 wheels, all of which have never yet been employed at once. There is also an immense ice house, a place for salting hides, storing tallow, hoofs, horns, etc., places for killing sheep, powerful steam pumps (used for washing the entire building, or in case of fire), offices, etc.—in short, every accommodation for the speedy transformation on a large scale of live stock into beef and mutton.

The process of killing beef cattle can be described in a few words. There are ten or twelve steers in a pen, some lying down, some standing. A man takes a stout rope, about one inch in diameter and three feet long, with loops at each end; he makes a slip noose of this, and fastens it on the left hind leg of a steer above the second joint, and attaches the loop at the other end to a hook on a rope of the same size, which goes over the wheel overhead. A crank is turned, and the animal is slowly but surely drawn from the pen. The doors of the pen are then closed, and the animal, endeavoring to keep his feet, falls, and his struggles cease. He is hoisted until all his feet are clear of the floor, when the butcher puts his left hand on one horn, turns the head around, and, with a very sharp knife, cuts the throat clean across. A pan made of galvanized iron, about two feet in diameter and six inches deep, catches the blood, which is poured into a large iron box on wheels, with a tight cover, to be used in refining sugar. After the animal has hung eight or ten minutes it is lowered, laid on its back, and kept in position by iron-pointed sticks on either side. The hide is taken from the head, the tongue is removed, and the head and horns are chopped off with an ax, leaving the horns attached to the hide, which is then detached from the belly and sides; the feet are cut off at the knees and thrown into another large box on wheels. The animal is then hoisted by a second wheel, a stout stick about four feet long having been placed in the sinews of the hind legs The belly is opened from end to end, the entrails are removed and denuded of their fat, and the heart and liver are taken out and hung on hooks. The carcass is then almost divided, and hoisted still higher, when the stick on which it is suspended rests on two beams running across the building at every wheel, and it is slid away from the place of killing. The whole carcass is then thoroughly washed and the division into sides made complete. The meat is then allowed to cool and harden until early next morning, when it is taken to the market. The average number of cattle slaughtered at this place daily is, in the summer, about 250 head, but in the fall and winter it is much larger.

The process of converting sheep into mutton differs materially from that pursued in killing cattle, being much simpler and easier. A butcher enters the pen where the animals are, seizes one, lays it on its side, with its head over a gutter that conveys the blood to the river, cuts its throat, and with a dexterous thrust with the knee breaks the spinal column, allowing the carcass to remain until seven or eight are disposed of in the same manner. The hind legs are then tied together with a piece of stout string, and each carcass is hung from a peg for skinning and dressing. The number of sheep killed daily varies from one to two thousand, according to the season.

The butchers are mostly Americans and Irish-Americans. Their ages range from twenty-two to thirty-five, with a few veterans and several boys. Their wages vary from eight to thirty dollars a week. They are a jolly, good-natured set of people, fond of their work. Almost any of them will tell you that they are never ill, and that it is about the only decent trade that is going. While at work they wear thick woolen shirts, trowsers thrust into rubber or stout leather boots, and woolen caps. Each man has a steel hanging at his left side, on which to sharpen his knives, which are kept, when not in use, in a sole-leather pocket, fastened to a stout belt and placed behind him. The knives used have blades about six or eight inches long, and curved like a saber. The other implements, such as cleavers, saws, and axes, are disposed in places convenient to their reach when needed.

DEATH OF A PROMINENT AGRICULTURIST, ENGINEER, AND MANUFACTURER.

ON the 1st day of October death removed, after a long and useful life, Johann Fichtner, founder of the first bone phosphate manufactory in Austria, at Atzgersdorf. Fichtner was born at Prossnitz, Moravia. After receiving a thorough school education he entered the Polytechnical Institute at Vienna, becoming, in 1819, assistant to Prof. Arzberger. In this capacity he constructed the first street locomotive ever built on the continent. After spending several years in England, he obtained in rapid succession several imperial privileges for improvements in distillation by steam, steam engines, boilers, and other machinery. He founded several large industrial establishments, conducting them very successfully. When constructing the machinery for the large calico print works of Josef Klein, of Atzgersdorf, he became acquainted with the daughter of the latter and married her subsequently. In 1827 Fichtner became partner of his father-in-law, and, after the latter's death, in 1840, sole proprietor of the extensive calico works. Legislation being, however, not favorable to that branch of industry, Fichtner converted the large establishment into a factory for bone phosphates and other artificial manure. This he conducted up to a short time ago, when he turned it over to his sons, living only to his studies.

Fichtner was a man who, like few, experimented on all fields of science, regardless of expense to himself and not easily discouraged by failures. The solution of many problems regarding the nutrition of the soil and the composition of the same best adapted to certain plants is due to his arduous labors. For years he experimented on the influence of magnetism, electricity, and galvanism on vegetable life; he published many valuable papers on drainage, artificial fructification of cereals, the opening up of the ground by nitro glycerine, the acclimatization of the silkworm, on artificial raising of fish, on the construction of agricultural machines and implements, in short, on most all subjects interesting to the scientist and the agriculturist in particular.

A member of many scientific and industrial societies, and officially honored in many ways, he nevertheless always declined public positions, in order to follow his studies more undisturbedly. Austria, and humanity in general, lose in Fichtner an unpretentious, but steady and successful worker.

RISE AND PROGRESS OF BEE CULTURE.

By A. J. KING.*

ALL the great inventions and discoveries which have developed the resources of the world to a greater extent within the past century than in all previous times since the creation, have had their origin, more or less remote, in the ages past. The various applications of steam, electricity, the mechanical powers, and the wondrous developments of natural science, which have so changed the face of all nature and the currents of thought within the past few years, are but the accumulations and scientific combinations of ideas and inventions, scattered all along the line of the ages by the past generations in their onward march from ignorance, superstition, and bigotry to intelligence, knowledge, and true science. Of all the fields of research in the development of national industries, none are more fruitful, inviting, and instructive to the antiquarian than the history of the culture of the honey bee, for in all his researches he will find himself in the company of the wisest and best minds of all ages. Poets, naturalists, philosophers, and doctors of divinity are largely represented in its history. Honey was regarded by the ancients as a present from the gods, and with it their libations were made around the tombs of those dear to them. With honey they preserved their corpses. With honey their gods were appeased by pouring it on their altars and heads of the victims. Honey was the only sweet known until within comparatively modern times. The Holy Scriptures abound in figures of the highest joys and the most exquisite sweetness, drawn from the bee and its delicious product. Aristotle pronounced the honey bee a magazine of the virtues. Virgil, the most eloquent of the Latin poets, calls it a ray of the divinity, and chose it as his subject for the best of his Georgics. Shakspeare, Milton, and, in fact, all the prominent writers, have bestowed on the bee at least a passing notice. De Montfort, who, in 1646 wrote a work on bees, estimates the number of authors who had written on this subject previous to his time, at between five and six hundred, the larger part of which are lost, but traces of most of them have come down to us through works published in the seventeenth century. These works, one of which was written by De Montfort, seem to unite the idea of the ancients with those of his own time. And the most romantic and foolish reveries stand side by side with sensible views, and in many instances the two are so badly mixed that to give in full the various views which have prevailed at different times in the past history of bee culture, would bring a result similar to what Milton says of the writings of the Fathers—a huge drag net, brought down the stream of time, filled mostly with sticks and straws, pebbles and shells, sea-weed and mud, with a pearl in the oyster here and there. We shall confine ourselves to the merest outline of this history, and endeavor to select as many of the pearls as we can in passing.

Of the antiquity of the bee we cannot speak positively; but the geological evidences of flowering plants, demanding insects for their fertilization, together with the remains of insect feeding reptiles, as well as herbivorous animals, places the bee, at least presumably, ages anterior to the creation of man. The positive proof of its early domestication are ample. The ancient Egyptian sculptures and tablets abound with hieroglyphics, wherein the bee is the symbol of royalty, their economy being represented with a monarch at its head. In most instances these representations are *rude*, and betray a lack of close observation, as the bee is pictured with two wings and four legs; however, on one tablet of the twelfth dynasty, the bee is figured correctly, having four wings and six legs. *Shuckard*, in his "British Bees," gives us indications of a still higher antiquity from the *Sanskrit*, wherein *Ma* signifies *honey; Madhupa, honey drinker*, and *madhumkara*, honey maker. He also traces the same in the Chinese dialects. The earliest Shemitic and Aryan records, the Book of Job, the Vedas, as well as the poems of Homer, are conclusive proof of the early domestication of the honey bee, all of which are interesting to the student of Apiculture. Of the *origin* of bees the ancients indulged the most extravagant fancies, some contending that they originated from the putrid carcasses of animals, probably from witnessing the transformation of insects as millers from moth worms, butterflies from caterpillars, etc. They give receipts to produce swarms of bees, the details of which are too disgusting to relate. Others, of finer and more poetic conceptions, imagined that bees were bred from the purest juices of the summer flowers. Virgil expresses something of this opinion in the following, from the fourth book of his Georgics: "Chiefly you will marvel at this custom, peculiar to the bees, that they neither indulge in conjugal embrace nor softly dissolve their bodies in the joys of love, nor bring forth young with a mother's throes; but they themselves cull their progeny with their mouths, from leaves and fragrant herbs. They themselves raise up a new *king*, and little subjects, and build new palaces of waxen realms." With all these false notions of bees, the ancients still possess much valuable knowledge. To Aristotle and Virgil we are indebted for the first description of Italian bees which, until recently, had been regarded as a myth. Virgil remarks as follows regarding the two varieties: "For the one looks hideously ugly, as when a parched traveler comes from a very dusty road and spits the dirt out of his dry mouth. The others shine and sparkle with brightness, glittering with gold. This is the better breed. From these, at stated seasons of the sky, you may press the luscious honey, yet not so luscious as pure and fit to correct the hard relish of the grape." Again he says: "There are two sorts, the one glorious with refulgent spots of gold, and is distinguished both by his make and conspicuous with glittering scales. The other is horribly deformed with sloth, and ingloriously drags a large belly."

Aristotle lived three hundred years prior to the Christian era. He wrote largely on every department of natural history. His pupil, Alexander the Great, placed at his disposal large sums of money, and employed, during his campaign in Asia, more than a thousand persons collecting specimens for his use from all parts of the animal kingdom. From his pen and those of his pupils we are indebted for much information of value in bee culture. Columella, about the commencement of the Christian era, wrote a large work on "Husbandry," in which he gives directions for the artificial swarming of bees, supplying queens to destitute colonies, transferring hatching brood to weak stocks, and many other useful operations of which the great multitude of bee keepers are ignorant to this day. Varro and Pliny also wrote in a manner which presupposes quite a knowledge of the brood nest, all of which leads to the belief that in those early classic days a very advanced knowledge of bee culture prevailed. What is known in history as the "dark ages" now came on, and for the space of nearly fourteen hundred years no progress was made in any department of natural history, but on the contrary, much was lost.

At the close of this era of mental darkness the celebrated John Ray appeared. He collected and arranged all which survived of the previous productions on entomology. Ray was succeeded by Linnæus, the inventor of the binomial system of classification which is still used by all investigators of natural science. At the close of the 17th century Swammerdam, Maraldi, and Réaumur wrote extensively on bees and hives, and Shirach, Reims, and others still later.

These writers discovered many of the facts connected with the secret working of the hive, which contributed largely in raising the vail of ignorance which still enshrouded this industry and paved the way for the prince of apiarians, the great Huber, who appeared about the close of the 18th century, and with whose history every apiarian, worthy the name, is more or less acquainted. He it was who, combining in one the unicomb observation frames of his day, removed their glass sides and gave to the world the first movable frame bee hive in existence, and by the aid of which he made those beautiful experiments which placed the science of bee keeping on the enduring basis of truth; experiments which established one by one nearly all the wondrous facts connected with the natural history of the honey bee, by the adoption of which bee keeping has gradually assumed national importance in all civilized countries. It is a fact that the blind Huber, through the eyes of his faithful servant, Francis Burnens, saw more and did more for rational bee culture than any one man before or since his time. The correct theory once established, prominent naturalists adopted it. Authors and inventors sprang up on every hand, and movable frame hives of different patterns were soon in use in various parts of Europe, Munn of England, Berlepsch of Germany, and De Bovois of France, being the most prominent, and all of whom have written extensively on the subject of bees and hives. It is estimated that from Shirach up to about 1847, one hundred and twenty-four books were written on bee keeping. Apiaries sprang up of larger dimensions than ever before, some noblemen owning as high as eight thousand stocks. The discovery of the process of refining sugar, made by the Venetians about the middle of the 16th century, was at this time in full blast in Germany, and served to distract attention from the production of honey, and sufficiently accounts for its decline about this time.

The engraving and description of the Munn movable frame hive may be found in the *Cottage Gardener's Chronicle*, London, 1843, page 317; also in the author's pamphlet in 1844. The De Bovois movable frame hive, which was almost identical with King's American bee hive, is fully described in the author's large book on apiculture, published in France in 1847. The Berlepsch hive, invented in 1840, was greatly improved in 1845, making it almost identical with the Langstroth. He further improved it, and published an illustrated description in the *Bienen Zeitung* for May, 1852. But bee culture in Europe was by no means carried on principally by those using movable frames. On the contrary, the great majority used either the straw hive, wooden, gum, or square box, with bars crossing the top, to which the combs were attached, and then either the storifying, nadir, or collateral system was resorted to for surplus honey.

At one time in France bee keeping was deemed of so much importance that in some places laws were enacted rendering it imperative on every cottager to keep at least three hives of bees, or in lieu thereof to pay a certain fine into the treasury. In England large rewards were given for the finest display of honey and beeswax of one's own raising, and obtained without sacrificing the lives of the bees. Prominent men wrote books on the subject designed entirely for the benefit of the cottagers, and the same unselfish course is still pursued in Europe.

A brief mention of some of the most useful inventions and discoveries must close our notice of the progress of bee culture in Europe. Dziertzon discovered the parthenogenesis of the queen bee, and Siebold, Leukart, Berlepsch, and other eminent German naturalists demonstrated it. Dziertzon also discovered flour to be a substitute for pollen. Mehring made the first artificial honeycomb foundation. Major Von Hruschka invented the honey extractor. The invention of bellows smokers adapted to the apiary is very ancient, they having been used in all parts of Europe for the past one hundred years or more. Some had straight and some bent nozzles, and some of the nozzles were hinged to the bellows, and were turned at right angles for draught when not in use, and also to receive the materials for the smoke. These might have been appropriately called breech loaders.

Réaumur first describes artificial fertilization of queens in confinement. His experiment called the "Amours of the Queen Bee," made under a glass vessel with the drones, is exceedingly funny, and sounds very modern, but is too lengthy for insertion in this notice.

Bees came with the Pilgrim Fathers to America, and were carried by the early pioneers to all parts, until now they are to be found in every portion of the Western Continent, but, owing to the many toils and cares incident to the development of a new country, together with their lack of knowledge of the subject, little attention was paid to them until within the past thirty or forty years.

(*To be continued.*)

* Read before American Bee-Keepers' Convention, Cooper Institute, New York, October, 1878.

DR. DAY, of Geelong, recommends as a disinfecting agent a mixture of one part rectified oil of turpentine and seven parts of benzine.